THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE MANUFACTURE OF ELECTRICAL MACHINERY DURING 1904.

REFERENCE has already been made in the ELECTRICAL REVIEW during the past few months to the disappointing financial results shown by the leading electrical manufacturers in this country, and some of the causes responsible for this state of affairs, as put forward at the annual general meetings by the chairmen of some of the principal companies concerned, have formed the basis of our leading articles of August 12th and of December 16th last.

Whilst there is little new to be added to the remarks already made in these articles, in which the difficulties encountered by Crompton & Co., the Electric Construction Co., and the British Westinghouse Co. were enumerated, it is not without interest at the present time to glance at the position of the electrical manufacturing industry in general.

In 1900 and 1901 sufficient orders were available to satisfy the manufacturing capacity of the country, but even during these years prices were somewhat depressed, due chiefly to the abnormal competition from abroad, and the standard of prices has fallen during the past three years to an extent which would scarcely have been thought possible.

The years 1902 and 1903, and, more than ever, 1904, have seen competition grow severer, with the result that at the present time most of our engineering shops are only partially filled with orders, and these at prices which must be far from remunerative.

During the past year practically no profits—at all events, none commensurate with the capital invested—have been made in electrical manufacturing, and the few firms that have shown some return to their shareholders have made their profits in departments chiefly outside actual manufacturing.

That matters have been getting worse during the past few years would seem to be accounted for by the fact that the manufacturing capacity of the country has increased, whilst the demand itself has, if anything, fallen back.

The question which we should all like to see answered is, When are things likely to take a turn for the better, and when can shareholders, with their capital locked up in bricks and mortar, and in plant laid down for turning out electrical machinery, hope for a reasonable return on their capital?

In some responsible quarters it is regarded as very doubtful whether any improvement can be looked for in the immediate future, and it is feared that much capital will have been lost, and that drastic changes will have taken place, before manufacturers can hope to do justice to the money—or to a portion of it—which they have buried in their business.

The most hopeful reflection, perhaps, lies in the fact that during our times of prosperity, namely, the years 1899, 1900 and 1901, manufacturers in Germany and on the Con-

tinent were passing through a crisis which resulted in heavy losses to most of those concerned in manufacturing; but that by careful organisation and subsequent amalgamation they have weathered the storm, and are at the present time in the midst of prosperity.

It is not unlikely that the past three years have only been leading up to a similar crisis in this country, and that any improvement is rather to be looked for after this crisis has passed than in a revival in trade. The discrepancy between supply and demand in our manufacturing industry would seem to be too great to justify the hope that any probable improvement in trade alone could bring about the desired ends.

There is nothing very striking to chronicle in the direction of new departures in the manufacturing world.

The steam turbine has made rapid strides, and has warranted several of our leading electrical manufacturers in laying down plant for dealing with the new requirements on no small scale.

Hitherto, in this country, in America, and also on the Continent, the manufacture of turbines proper, and of the necessary electrical machinery, has been in the hands of firms who have manufactured both, and the first exception to this custom is found in the steps taken by Messrs. Willans and Robinson, Ltd., who have decided to satisfy themselves with the manufacture of the turbines alone, leaving the electrical portions to those who have made electrical work their speciality. In this way the demand created for the necessary electrical machinery has already been met by Messrs. Dick, Kerr & Co., and Messrs. Siemens Bros. & Co., both of whom have laid themselves out for dealing with the electrical portion of the combinations. In addition Messrs. Bruce Peebles & Co. have built several alternators for this class of work, and Messrs. Crompton & Co. are also, we believe, making arrangements for dealing with the demand from the turbine market.

It will, therefore, be seen that considerable attention is already being paid by electrical manufacturers to this development of the business, which promises, in the near future, to replace to a large extent the present forms of generator for direct coupling to reciprocating engines.

It is quite to be hoped that, by specialising in one portion of the combination alone, instead of attempting to deal with both, most satisfactory results will be achieved; and it is, at all events, promising that the further development of this new form of prime mover should have been undertaken by specialists of such high standing in their respective spheres as the firms named above.

The competition of the future in this class of machinery promises to come more and more from those who are members of one of the large Continental or American rings—more especially the competition in our colonies—and it is only by producing on the best possible lines, namely, by specialisation, that our smaller concerns can hope, in open competition, to hold their own. In this way they will, we believe, in many cases, be able to defeat the formidable, though, perhaps, somewhat unwieldy trusts.

In addition to the steps taken to meet the demand for turbines by the individual firms named above, there are several other manufacturers in this country who are dealing with the turbine business by manufacturing the combined sets. Besides Messrs. C. A. Parsons & Co., we have their licensees, the British Westinghouse Co., the Brush Co., and Messrs. Richardsons, Westgarth & Co., and also the British Thomson-Houston Co., who are exploiting the "Curtis" turbine patents in this country.

No little activity is, therefore, likely to be displayed in the near future in the turbine business, and it is quite to be expected that this competition will succeed in introducing very pronounced improvements into both the design and manufacture of this modern prime mover.

A Dutch Tramway Scheme.

In this issue we give an account of a remarkable example of tramway construction under exceptionally difficult conditions, such as are to be met with nowhere but in Holland. Apart from the engineering features, however, the scheme is interesting on other counts. Dutch in its inception, it was financed by an American firm, constructed by a company domiciled in England, and built of materials supplied by English, French, German, American, Dutch and Belgian establishments, besides, probably, Norwegian and Swiss firms. The aim, in fact, was in every instance to purchase sound materials and apparatus in the cheapest market, regardless of the labour and trouble involved, and this object, we believe, was accomplished with satisfaction to all concerned. Another interesting feature is that the work was carried out subject to a maximum guaranteed price, and in spite of the many obstacles and delays which were experienced, from causes beyond the control of the contractors, the actual cost was kept below this figure by a very satisfactory percentage.

The attitude of the local municipalities towards this scheme, which, besides being a possible source of profit to the projectors, will undoubtedly prove highly beneficial to the inhabitants of Amsterdam, Haarlem and Zandvoort, by providing an alternative and convenient means of transit, and by reducing the fares on the railway with which it is in competition, presents a striking resemblance to that of too many of our own local authorities. No one is more ready than the latter to claim railway and tramway companies as "public servants"—when the undertakings are in operation. Yet, in the preliminary negotiations, these future "public servants" are treated like the goose that laid golden eggs, and are often throttled in the effort to extort the uttermost farthing from their unwilling purses. Strange it is that our municipal representatives can only think in £ s. d., and are unable to appreciate the public benefits that would ensue from the encouragement of private undertakings such as these, to say nothing of the reduction of municipal indebtedness and of the burden of rates.

The P.M.G. and Wireless Telegraphy.

The announcement that arrangements have been made by the Postmaster-General to receive prepaid telegrams for transmission to Altantic liners by wireless telegraphy marks an epoch in the history of the latter in this country. The new agreement will undoubtedly prove of great convenience and utility to the general public, and will go far to heal the troubles of the shareholders of the Marconi Co., sore with many disappointments. Had the directors of the company confined their endeavours to the perfecting of their means of communicating between ships, and between ship and shore, instead of wasting their substance on unprofitable and premature attempts to open communication with America, we believe that the concession now in force could, and would, have been granted long ago, and the position of the company would have been far stronger at this moment. One must walk before one can run—and crawl before one walks. We trust that the lesson has been well digested, and that the company will now devote itself to the development of a sound business, in which it will have the good wishes of everyone.

THE PRODUCTION AND UTILIZATION OF OZONE.—II.

By JOHN B. C. KERSHAW, F.I.C.

(*Concluded from Vol.* 55, *page* 1053.)

Niagara Falls.—Otto, the French engineer and designer of various types of ozoniser, has been in America recently, and while there has conducted experimental trials with his ozoniser for water purification at Niagara Falls, using the generating plant of the Atmospheric Products Co. for this purpose. A pressure of 50,000 volts was employed in the experiments, and Otto estimates from the results obtained that a 30 to 40-H.P. plant would suffice to purify 6,000 tons of water daily.

The very important point of the state of the water supply as regards its degree of purity and suspended matter does not receive mention, and in the absence of this information, Otto's estimate is of little value.

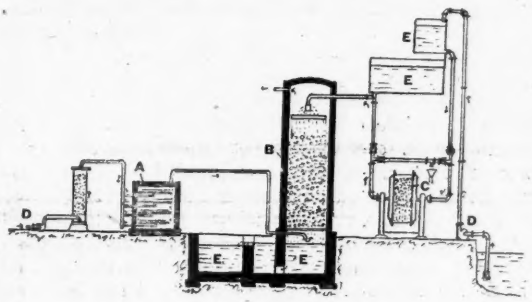


Fig. 4.

No permanent installation of ozone for water purification purposes is known to the writer in the U.S.A. A process based on the use of an electric current with aluminium electrodes is stated by Langley to be in regular use at Cleveland, Ohio. The action in this case, however, is chemical, as the current produces aluminium hydrate at the anode, and this then separates out as a flocculent precipitate, and carries down the impurities of the water.

Martinikenfelde, near Berlin.—The plant at this place is experimental only, it having been erected by Messrs. Siemens and Halske, of Berlin, in the year 1898, to demonstrate the possibility of applying ozone, on an industrial scale, to water purification and sterilisation.

The plant was designed to treat 240 cb. metres of water per 24 hours, its general arrangement being illustrated in fig. 4. It comprised a battery of ozonisers, A, of the Siemens and Halske tube type (see last article for description), a sterilising tower, B, a sand filter, C, for filtering the water before entering the tower, and the necessary pumps, D, and storage tanks, E. A large number of experimental investigations of the effect of ozonised air upon water from the River Spree, which is very impure and contains a very large number of bacteriological organisms, were carried out at this place in 1901, and Drs. Oblmüller and Prall, of the Imperial Health Bureau, in Berlin, reported fully on the results obtained during their trials. The number of bacteriological organisms were stated to be reduced from 100,000 to 10 per cb. metre by the combined sand filtration and ozonised air treatment, while the estimated cost was 5·9d. per 1,000 cubic feet of water, slightly over one half of this total representing the cost of the electrical treatment. The capital outlay upon the Martinikenfelde plant is not stated, but it was estimated that a plant of similar design for treating 3,600 cb. metres of water per day could be erected for £7,700, this total covering all the pumping, filtering, storage and electrical plant required for the installation. The writer believes that the Martinikenfelde plant is still intact, and that it is in occasional use for demonstration purposes.

Schierstein-Wiesbaden.—A detailed account of the plant erected by Messrs. Siemens & Halske at this place was given in the Electrical Review on January 2nd, 1903 (p. 13), and it is unnecessary to repeat much that is contained in that article. Fig. 5 shows the plan and two elevations of the Schierstein ozone water purification works—the first of their kind erected in Germany for work upon a commercial basis; and fig. 6 shows one portion of the ozoniser building, with the electrical, water and air connecting wires and pipes.

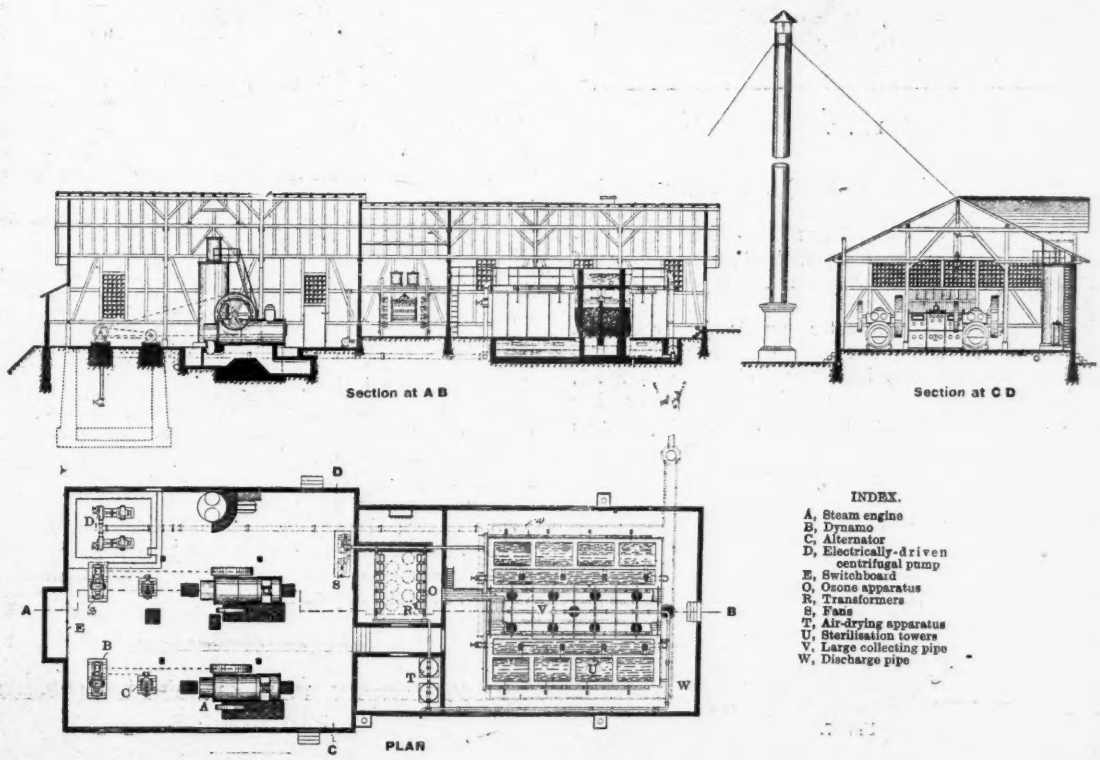


Fig. 5.

The writer was one of those present at the fifth International Congress of Applied Chemistry at Berlin in June, 1903, when Dr. Erlwein described the above plant, and gave some figures for the results obtained since its inauguration for water purification purposes. In the course of the discussion upon Dr. Erlwein's paper, the fact was elicited that considerable trouble had been experienced at Schierstern, owing to the presence of some organic compounds of

iron in the natural water. This separated out as ferric hydrate during the ozone treatment in the sterilising tower, and caused the water to assume a dirty yellow colour. At the date of the fifth International Congress it was admitted that the Schierstein ozone water purification works were stopped owing to this trouble. From Dr. Erlwein's most

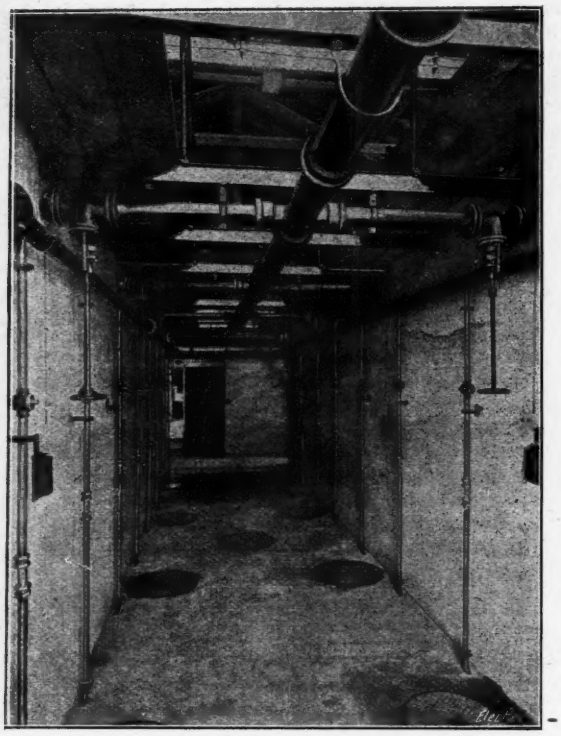


Fig. 6.

recent paper (read at Zurich in 1904), it is not clear whether the difficulty has yet been surmounted, since it is stated therein that the water produced by the works cannot be considered a proper substitute for potable water. The cost of the ozone treatment at Schierstein is 2 pfg. per cb. metre, equal to 6·7d. per 1,000 cb. ft.

Paderborn.—The ozone water purification works at Paderborn were erected about the same time as the works at Schierstein, and are shown in sectional elevation in fig. 7. The plant comprises dynamos, centrifugal pumps, ozoniser battery, A, sterilising towers, B B, and the necessary storage

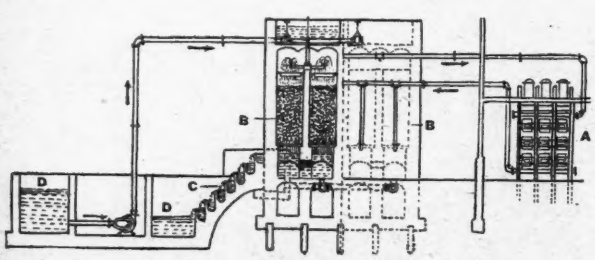


Fig. 7.

tanks, D D. The water used is from the River Pader, and the plant is designed to treat from 1,440 to 1,720 cb. metres per 24 hours. The average consumption of ozone is 1·3 grammes per cb. metre of water, and the ozonisers yield 13·5 to 27·0 grammes per E.H.P.-hour, the maximum being obtained with dry air and a slow current. The sterilising towers are 13 ft. in height, and are divided vertically into four compartments; they are constructed of concrete, and filled with flints. The water, passing from the towers after treatment, falls away over cascades C, in order to remove the last traces of ozone. This works has been in operation since August, 1902, and it is reported to be supplying the whole of the water required by the population of Paderborn, with satisfactory results. The cost of treatment works out to 1·60 pfg. per cb. metre—equal to 5·35d. per 1,000 cb. ft.

Conclusion.

The above facts and figures prove that the use of ozone for water purification and sterilisation has emerged from the experimental stage of its development, and that under certain conditions this method of purification can be operated with successful results—both commercially and otherwise. The conditions required to make such an installation a success, however, are exceptional, and it seems unlikely that ozone, or, more correctly, ozonised air, will be employed on a very extensive scale for sterilising the water supply of great cities.

As pointed out by the writer once before, it is both cheaper and safer in such cases, to go far afield for water, and to obtain a pure supply, than to take the polluted river water that happens to be near at hand, and to purify it by treatment with ozone in special purifying plants.

But, in small towns and villages, where the initiation of large waterworks schemes is impossible owing to the financial outlay involved, the ozone treatment for purifying and sterilising an impure water supply near at hand would seem to have a future field of usefulness. The Schierstein and Paderborn works are examples of such installations. Messrs. Siemens & Halske estimate that a plant capable of dealing with 126,000 cb. ft. of water per day could be erected for an outlay of £6,400, this cost covering all the pumping and filtering plant of the waterworks—and installations half this size would, no doubt, prove sufficiently large for many small town and village communities. The possession of an ozone sterilisation plant, as a stand-by in times of severe epidemic of typhoid, enteric and similar fevers, would also be an aid to the preservation of health in large city communities, since at such times the ozone plant could be put into use, and the water supply to the affected district of the city could be thoroughly sterilised.

The purification of water by ozone would also appear to have a future in works where drinks and beverages of all kinds are manufactured for public use, and possibly also on board ships and in military camps, where the necessary supply of steam or electricity for generating the current can be obtained.

While the application of ozone to water purification is unlikely, therefore, to revolutionise the present system of obtaining water for drinking and other purposes in our great cities, it will undoubtedly help in certain cases and under certain conditions to solve the problem of a pure water supply, and as the yield of ozone is increased by improvement in the form and working of ozonisers, this field of usefulness is likely to widen and extend.

Since the theoretical yield of ozone per E.H.P.-hour is stated to be 1,000 grammes, and the maximum yet obtained is 184 grammes, or an efficiency of only 18·4 per cent., there is still ample room and opportunity for improvements in ozonisers; and the progress in the ozone industry is likely to depend very largely upon the success of inventors in turning to useful work some portion of the 82 per cent. of electrical energy still unaccounted for in the usual form of ozoniser tube and apparatus.

PHOTOMETRY FOR CENTRAL STATION ENGINEERS.

By LANCELOT W. WILD, A.M.I.E.E.

Central station engineers are every day becoming more alive to the importance of being able to make photometric tests on the incandescent lamps supplied to their consumers. The apparatus hitherto employed, however, has not generally been that most suitable for the purpose. Apparatus intended for use in a laboratory is not necessarily the best to use in a central station.

The object of this article is to describe how photometric measurements may be made in a central station both accurately and quickly, and without employing any very

expensive apparatus, nor yet a specially skilled testing staff.

The apparatus required for making the tests may be classified as follows:—The light standard, the photometer bar, the comparison box, the electrical measuring instruments and regulating resistances.

The Light Standard.—The standard of light now most generally accepted in Great Britain is the 10-c.p. Vernon Harcourt pentane vapour lamp. This lamp gives 10 c.p. under certain definite atmospheric conditions only. For any atmospheric conditions other than the standard, corrections have to be made for CO_2, water vapour, &c. For this reason, the lamp is hardly a practical standard, except in the hands of a specially skilled operator.

For general testing work, the best working standard is an incandescent lamp. As, however, the candle-power of an incandescent lamp varies as about the seventh power of the pressure at its terminals, it is necessary to provide means of maintaining a very steady voltage at the lamp terminals, as well as means of measuring that voltage with a very high degree of accuracy, if absolute candle-power measurements are to be made. This means that a potentiometer must be used for measuring the voltage, and that cells must be used for providing the current.

For central station testing it is better to use a standardised incandescent lamp of the same voltage as, and run in parallel with, the lamp to be tested. With this system, fluctuations of voltage up to, say, 5 per cent. above or below the mean, are of little consequence, as both lamps are affected by the variation to nearly the same degree. This simplifies the work enormously, as the necessity of using a special battery of accumulators and a potentiometer is avoided. Much less skill, also, is demanded from the testing staff.

The standardisation of the standard lamp is best left in the hands of those institutions making a speciality of such work.*

Great care should be taken in selecting a lamp to be used as a standard. In the first place, the lamp should have a clean well-fitting cap, or otherwise errors will occur due to bad contacts. A lamp should be chosen that can be turned through an angle of, say, 15°, without the candle-power varying more than 2 per cent., otherwise errors may occur due to the lamp being badly centred when in position. The lamp should be run at normal voltage for from 200 to 500 hours before being standardised, otherwise it will not maintain its candle-power for any length of time, without showing considerable variation. The inefficiency of the lamp selected should not be less than 4 watts per candle-power, and 4½ to 5 watts per candle-power is preferable, in order that constancy of candle-power may be maintained. The cap should be marked with a well defined vertical line in order that the correct position of the lamp on the photometer shall be shown.

The Photometer-bar.—In order that quick measurements may be made, the photometer should be direct reading. This is best attained in the following manner.

The scale should be marked in candle-power with zero about central, the figures for candle-power increasing on each side of zero to, say, 20 candle-power on one side and 40 candle-power on the other. The graduation should be such that the figures increase as the square of their distance from zero.

The comparison box should be permanently fixed over zero. The standard lamp should be mounted on a movable carriage, which should be placed immediately over the scale reading corresponding to the true candle-power of the standard lamp at its marked voltage. The lamp under test should be mounted upon another movable carriage. This carriage should be provided with wheels, and should be attached to an endless cord running over pulleys at each end of the bar, so that the lamp may be moved to and fro by the operator without the necessity of his having to take his eye from the comparison box. When the lights have been balanced the true candle-power of the lamp under test at its marked voltage may be read off from the scale. No calculations are required.

One great advantage of this system of employing a photometer is, that no matter what the candle-power of the lamp under test may be, the illumination on the comparison box is always the same.

Should a lamp be required to be tested that is beyond the range of the scale on the bar as used in the ordinary way, the range may be doubled by moving the standard lamp closer to the comparison box, so that it stands over a scale reading equal to half the true candle-power of the standard. The photometer scale then has a constant of two and the reading for the lamp under test has to be multiplied by two.

Comparison Box.—Without doubt the best form of comparison box is the Simmance-Abady flicker photometer. This photometer is as sensitive as any, and has the additional advantage that all errors due to colour differences are eliminated. The next best form of photometer is, in the writer's opinion, the old-fashioned grease spot. This form also is very sensitive as long as the grease spot screen is kept clean. The objection to this form of photometer is that different results are obtained according to the side from which the screen is viewed. If, however, the mean of the two results is taken, a very high degree of accuracy is obtainable.

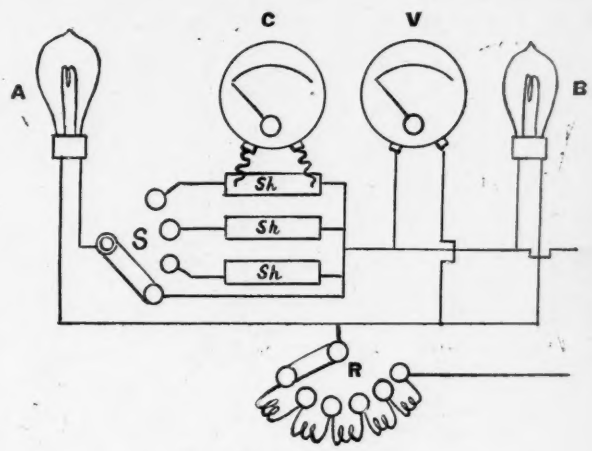


Diagram of Connections.

Electrical Instruments and Regulators.—The electrical instruments required are a voltmeter, preferably with an amplified scale, and an ammeter with three shunts suitable for 8, 16 and 32-c.p. lamps respectively.

A regulating resistance with at least 20 contacts is required for the purpose of regulating the voltage whilst the current taken by the lamp under test is being measured.

A four-way switch is required for the purpose of switching in the ammeter shunt and for short-circuiting the ammeter whilst the candle-power test is being made, thus throwing the two lamps directly into parallel, with exactly the same volts on each lamp.

A diagram of the best way of making the connections is given in the above figure: A is the lamp under test, B is the standard lamp, sh are the three ammeter shunts, C is the ammeter, V is the voltmeter, S is the switch for selecting the right shunt, R is a rheostat for regulating the voltage at the instant that the current is being read.

Direction in which Candle-power should be Measured.—Incandescent lamps are generally rated by their maximum horizontal candle-power. In lamps of ordinary construction, the mean horizontal candle-power varies from 99 per cent. to 92 per cent. of the maximum horizontal candle-power. The mean spherical candle-power varies from 84·5 per cent. to 83 per cent. of the maximum horizontal candle-power. Some people judge lamps by their mean horizontal candle-power. This is hardly fair, as the total quantity of light emitted is measured by the mean spherical candle-power. As the measurement of mean spherical candle-power is a very tedious task, it is better to measure the maximum horizontal candle-power only. As the ratio of mean spherical candle-power to maximum horizontal candle-power is almost con-

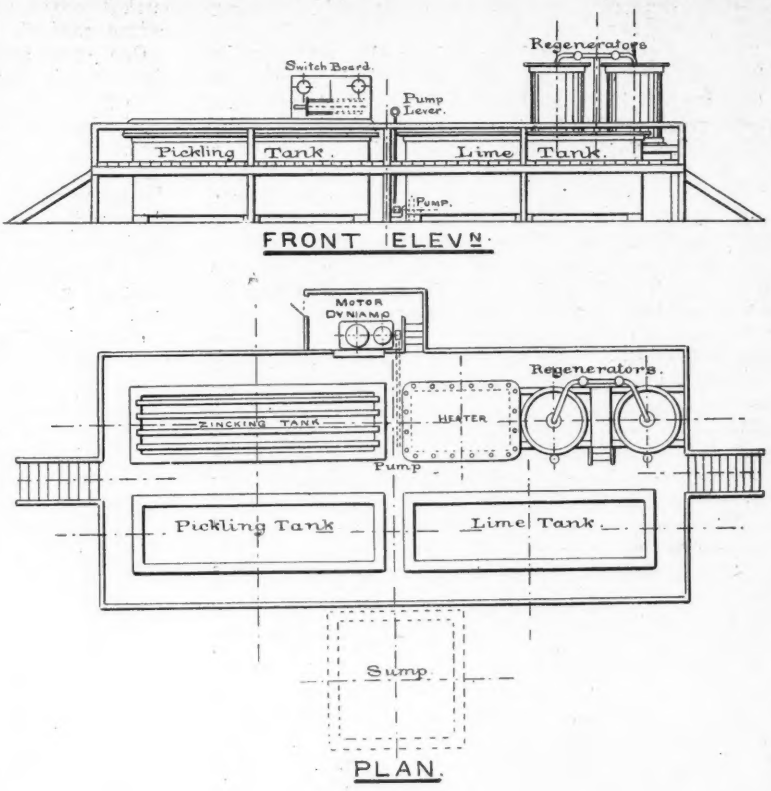
* Lamps to be used as standards, can be sent for standardisation and comparison with the Harcourt 10-c.p. pentane lamp to either of the three following institutions:—The National Physical Laboratory, Westminster Electrical Testing Laboratory, or the Electrical Standardising, Testing and Training Institution.

stant, this proceeding is fairer than measuring the mean horizontal candle-power.

The centre of gravity of the filament is not always in the vertical axis of the lamp bulb. The result of this is that when the candle-power of the lamp is measured on opposite sides, the results do not always agree. The mean of the two readings taken from opposite sides of the lamp gives the correct candle-power, and it is this mean which should always be taken as the true maximum candle-power of the lamp, and the candle-power at which it should be rated.

Effect of Stray Light and Reflections.—It is not necessary that the photometer room should be absolutely dark, so long as no light from outside can fall upon the comparison box. There is, in reality, greater danger of errors occurring from reflected light originating from the lamps on the photometer. Too much reliance must not be placed upon black surfaces. Black cloth often reflects as much as 5 per cent. of the light falling upon it, and black paint sometimes as much as 10 per cent. All reflecting surfaces, even when black, should be at such a distance that any light originating from the lamps and falling upon them shall have to travel many times as far as the direct rays from the lamps before reaching the comparison box.

When setting up a photometer for the first time, errors due to reflections should be searched for in the following way: An incandescent lamp should be placed on each side of the photometer, and their candle-power compared. This should be repeated with the lamps placed at various distances from the comparison box. The whole performance should be gone through again, with the lamps reversed, the left-hand lamp being changed over to the right hand, and *vice versâ*. If all the results obtained are in agreement, the photometer has been properly set up. If the results are not in agreement, a careful study of their divergence will probably indicate where the fault lies.



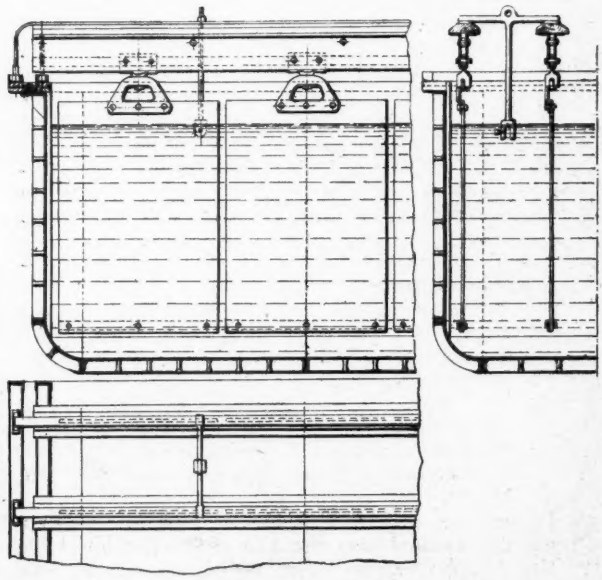
Figs. 1 and 2.

A RECENT ELECTRO-ZINC PLANT.

Electro-galvanising continues to make steady progress, and new plants are continually being erected. The process is largely used by the English and foreign Governments for two purposes, viz., as a protection for steel tubes for boilers during the time of assembling and erection, and also for the purpose of detecting flaws in the tubes in the early stage of construction, as it is found that the tubes, after pickling, if flashed with a thin coating of zinc, readily show any inherent flaw.

One of the latest plants erected under the Cowper-Coles process, which has the advantage of being practically automatic, so that it may be placed in the hands of any unskilled workman, is that installed at the works of Messrs. Aktiebolaget Sandviken, Finland. Figs. 1 and 2 show the plan and elevation of the plant.

The plant consists of a galvanising tank of 20 ft. long, which is connected to two regenerating tanks, in which zinc dust mixed with coke is placed for replenishing the zinc in the electrolyte as it is electro-deposited on the iron plates. A lead lined centrifugal pump driven off the dynamo shaft is used for circulating the electrolyte. It is found that by the adoption of this process great economy is effected as the whole of the zinc employed is used. When zinc anodes are employed, a very large percentage of the anodes crumbles away into the electrolyte and has a tendency to form rough deposits of zinc, the result being that only a small proportion of the zinc in the anodes is used beneficially. The anodes employed in the Cowper-Coles regenerating process are lead, attached to compound anode and cathode bars,



Figs. 3, 4, and 5.

figs. 3 and 4, which effect a considerable saving, as this arrangement enables the electrodes to be brought much closer together than would otherwise be the case.

Motor-'Buses.—The London Road-Car Co., Ltd., is making an issue of £116,004 (in £6 shares) among its shareholders and debenture stock-holders for the purpose of substituting mechanically-driven vehicles for its present horse cars. The substitution is to be carried out gradually, and no diminution in receipts is expected while the change is being effected. The new type of car will carry a larger number of passengers than the present, but a smaller type will be provided to meet the special requirements of certain routes.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Climax Boilers.

Our attention has been drawn to your comments on Mr. Cummins's paper on "Water-tube Boilers" made in your issue of Dec. 16th. We must refute entirely the statements you make with reference to the Climax boiler, and express our surprise, in view of the reputation this boiler has built up for itself in this country, that you should select it for such unjustifiable criticism. Such criticism is the more unwarranted, since, had careful investigation been made before publishing, it would never have been written.

That any boiler burning smokeless coal will make smoke, is a fact, if true, that will no doubt interest many of your readers, but, as far as the Climax boiler is concerned, this is impossible. For your information, we may add that we have sold Climax boilers with the guarantee that "they shall not make sufficient smoke as to be deemed a nuisance by the local authorities," and before these boilers were taken over they were subjected to the required test and accepted as having satisfactorily fulfilled the guarantee. We are also still willing to install Climax boilers on the same guarantee.

Further, you have evidently failed to familiarise yourself with the construction of the furnace of this boiler, otherwise you would be aware that good combustion is secured by means of the special patent design of furnace brickwork.

Users of the boilers, and they are most capable of expressing an opinion, find no difficulty in getting coal either to the boilers or on to the furnace grate; in fact, the reverse. Owing to the disposition of the fire doors, the labour of hand-firing is considerably reduced, and a boiler room filled with them need never be in a state of dust, dirt, or grime.

B. R. Rowland & Co., Ltd.
B. R. Rowland, *Director.*

Reddish, *December 23rd*, 1904.

[We do not dispute the possibility of getting coal to the boiler, but we do think it would be better to place the boilers in a row with an outside oven furnace to each boiler. Unless the lowest tubes are very high above the grate surface, we fail to see how it is possible to arrange the furnace so that there shall be space and time for the thorough combustion of bituminous coal. This has never yet been effected by any boiler economically without ample space and time prior to exposure of the furnace gases to cold tubes. We are willing to publish a drawing of the setting on which our correspondents rely for smokelessness, so that our readers may have the opportunity of seeing it. As for the "dust, dirt and grime," we spoke of what we had actually seen in a large boiler plant of this type.—Eds. E.R.]

Starting Current of a Lift.

I have read occasionally of other people's troubles with lifts, but lately it has come to our station, and we find it serious.

The trouble is due to the intermittent nature of the load. The large starting currents interfere with the supply to other customers, and under existing regulations the supply company could refuse to supply energy to lifts on that account. It is, therefore, desirable that the lift motors should be provided with such windings as to allow of a series-parallel method of control.

I have carefully measured the current taken by a goods lift in this town, and find that the current at starting is 36 amperes; it falls in 2 seconds to 30 amperes; it then falls slowly, and remains steady at 26 amperes (the cage ascending full loaded or descending empty). If this lift had a series-parallel control the starting current would be 18 amperes, falling to 15, and then rising to 26 amperes. I may say that this lift user is not treated here as a motor user. He is treated as a customer with a maximum demand of 8 kw., and using an insignificant number of units. If supply stations generally treated lifts in this manner, we would no doubt soon have a series-parallel system of lifts' motors. Maybe such a system exists.

Elevator.

Electric Riveter.

Can any of your readers please tell me where a small electric riveter is to be obtained, to be suitable for using on $\frac{1}{4}$ in. iron rivets cold, and if possible made for two-phase 50 period supply.

Stores.

Moving-Iron Instruments and their "Magnetic History."

In view of the interesting figures given by Mr. G. F. C. Searle in his recent paper before the Institution of Electrical Engineers, it occurred to us to investigate the possible error introduced into the readings of moving-iron ammeters and voltmeters working at low magnetic inductions.

It is well known that, for many reasons, it is of great importance to keep down the induction in instruments of this description when used for alternating currents, but it appeared possible that, in the case of direct current instruments, the low inductions employed might introduce errors due to varying "magnetic histories." To determine this point, a low-reading "Universal" moving-iron ammeter was tested, and calibration curves taken under various conditions. It may be noted that the induction in the moving-iron in these instruments is kept exceptionally low so as to avoid frequency errors when used with alternating current. Hence, it was thought possible that the readings might be affected by a direct current overload.

In the first place, the instrument was thoroughly demagnetised, and a set of up-readings taken. It was then again demagnetised and a downward curve obtained. After this, the instrument was overloaded to the extent of some 700 per cent., and another upward and downward curve obtained.

It was found that the mean difference in the reading, brought about by this exceptionally drastic treatment, was as follows:—At full load, ·5 per cent.; at two-thirds full load, ·1 per cent.; at one-third full load, ·6 per cent.

It will thus be seen that the influence of the previous "magnetic history" can, for all practical purposes, be entirely neglected in this type of instrument as manufactured by us.

Everett, Edgcumbe & Co.

London, E.C., *January 2nd*, 1905.

Water-cooled Iron Wire Rheostat.

The following may be of interest to your readers if it has not already been noticed in your columns:—

A few weeks ago a short paragraph appeared in the *Engineer* describing a water-cooled iron wire rheostat used by M. Weber, of Nancy, for dissipating electric energy during a dynamo test. It consisted of six lengths of iron wire, each ·128 in. diameter and 65 yards long, wound into coils and placed side by side in a wooden box with terminals at the ends of the coils connected up in parallel. This arrangement dealt with a current of 1,660 amperes at 500 volts. About 27 gallons of cold water per minute were passed through the box. The test lasted five hours, and the wires showed no sign of deterioration. Each coil carried 1,660/6 = 276·17 amperes. The current density was 25,300 amperes per sq. in. The theoretical drop in each coil is only about 247 volts, or, say, 50 per cent. of the actual drop. Admiring the compactness and cleanliness of such an arrangement, but doubting the recorded drop, we had a small coil fitted into a box about 30 in. long. The wire was of steel ·0085 in. diameter and 25 ft. long wound into a coil $\frac{3}{8}$-in. diameter and $\frac{1}{10}$-in. pitch. It was connected to the 220-volt service in this city, and theoretically should have passed 10 amperes, but only 5 amperes would pass, and about half the length of wire had to be removed before 10 amperes would flow, confirming M. Weber's record. We

are not able at present to explain how this result comes about, but it seems to us to be interesting and worth investigation. The current density was 176,000 amperes per sq. in., an amazing amount, but the wire carried it perfectly well. Clean tap water was used in the box to keep the wire cool. As the water is not intended to act as a conductor no acid or salt is necessary. Any addition of that kind would no doubt lead to rapid corrosion of the wire. Subsequently we used two coils of this kind in parallel for testing a 75 KW. plant at 220 volts. The wire was of iron ·0625 in. diameter. The box was 7 ft. long and 12 in. × 6 in. inside. There were four coils in the box, intended for testing two 75-KW. sets in parallel, but only one set was then tested, and only two coils were used. A small stream of tap water was passed through the box, but on this occasion its volume was not measured. The temperature of the water rose only a very few degrees. The apparatus answered perfectly and gave no trouble whatever. The current density was 56,000 amperes per sq. in.

A very convenient arrangement is to put four coils in a box side by side, with the terminals at one end provided with holes through which a horizontal copper bar can be passed and clamped. When the bar connects all four terminals in parallel the coils carry full load. When withdrawn from one terminal, three coils carry three-quarter load, two coils carry half load, and one coil carries quarter load. If switches be added the load can be varied very quickly. A final adjustment of load within small limits can be made by varying the quantity of water passing through the box, for the resistance of the wire rises and falls as the temperature rises and falls, and the temperature depends upon the quantity of water passing through. The chief value of the device is in testing generating plants after they have been erected at the purchaser's works. Compared with a set of tubs, such as we have seen used, containing lead plates and salt water, replenished, when the tubs boil over, by a jet of water from a hose pipe, directed by a man standing on an insulated platform, the Weber contrivance is elegance itself, and would, we are sure, be greatly appreciated by any of your readers who might give it a trial.

Henry Lea & Son.

Birmingham, *December* 31*st*, 1904.

Is Steel Conduit Wiring Doomed?

Your correspondent Mr. Moss, in asking the above question, can hardly suggest that the tendency of the times would warrant an affirmative answer. Undoubtedly, as he hints, the scandalous manner in which some so-called steel conduit systems are erected, gives ample room for complaint, but that a properly earthed, enamelled, screwed steel conduit job is the ideal one, is fast becoming the universal belief of consulting engineers and contractors alike, who have had real experience in all kinds of wiring work.

I know of a recent case where London contractors of repute obtained, on work of over 800 lights, the splendid result of 25 megohms on their insulation test. They are, however, experts in this class of work, and their reputation compels them to use only good conduit, installed by a competent staff of mechanics. Surely this result is good enough!

The fault of bad conduit systems, to my mind, lies at the door of consultants, whose specifications in this important matter too often lack definiteness as to the quality of material to be used, the number of inspection and draw-in fittings to be inserted, and the minimum clearances the cables should have in the tubes. Many contractors of standing will, even on a lax specification, include, on their own initiative, only good material, viz., mild-steel tubing of substantial gauge, with threads that are cut, and not merely scratched on the tubes, and a proper arrangement of inspection and draw-in fittings.

They have a reputation for good work to sustain, but, on the other hand, there are many contractors, unscrupulous in their methods, who, in competing for work, will include just the thinnest rubbish they can calculate to pass muster, and too often important contracts go to such people, when the difference in the purchase value of the two classes of conduits, added to their total tender, would have placed their price above that of other contractors accustomed to more honest and reliable work. I know of dozens of instances where such a thing has occurred.

The *raison d'être* for a conduit system, is that it should have perfect electrical continuity, and be a strong mechanical protection to the cables within. It should be a system bearing the hall mark of permanency, and so erected, that upon any fault occurring, the erring circuit can be readily located, and the cable drawn out and easily replaced without any damage being done to the decorations or structure of a building.

With Mr. Moss I can concur in hoping that the day of some steel conduit—so thin often, that it would not withstand the prick of a tin tack, and of a composition in which there is apparently more dirt than steel—is fast coming to an end. With high-class conduits and fittings, of the best material and workmanship, of strong and sufficient gauge, to be obtained so cheaply as they are to-day, I must, however, express the opinion that the demand will prove a growing one, more especially as one is pleased to see that the specifications for conduit systems are being drawn to-day in a very much more precise and mechanical way, by our leading engineers, than was wont to be the case before so many cheap and nasty varieties were on the market.

D. M. Edwards.
Conduits & Fittings, Ltd.

London, *December* 30*th*, 1904.

I should like to say a few words concerning the use of steel conduit for wiring installations.

I think it totally unsuitable for any kind of building, and as electrical engineer at a large colliery I have proved it to be quite a nuisance, as when a fault occurs (which is quite possible at any time) it is necessary to take down nearly three times more than is necessary to get at the fault; thus where there is no gas as a substitute, it means a great delay and inconvenience to those who use the light, and is a source of trouble to the electrician.

Only quite recently I had to have a building completely re-wired in casing and the tubing taken out. I found that tubing resists hardly any damp, and unless it is electrically continuous and well earthed, the leakage is so great as to render it dangerous to handle. I can see but one point in its favour, that is, mechanical protection; but there are many points of disadvantage against it, too numerous to mention here. I have come to the conclusion, as I think many others have also, that the steel tubing as a conduit is a costly and worthless system.

To my mind, what is needed to supersede wood casing, and at the same time afford good mechanical protection, and easy accessibility should faults occur, is a conduit made on the principle of a trough with a loose cap, which could be made damp-proof, the conduit to contain a uralite division, to stop the crowding of wires of different polarities into as small a tube as possible. The same need not be of a clumsy design, and could, if exposed to view, be painted, &c., so that it would not be an eyesore.

I think if some such conduit were brought out it would be found to fulfil all the requirements of the tubing and casing, and could be erected quite as cheaply. Furthermore, the wires, &c., could at all times be examined by the removal of the front; to my mind, the chief drawback to tubing is that the wires are crowded in, and no one can see whether they are in good condition or bad without pulling half of the installation down. Thus it proves a source of trouble and anxiety to an engineer, because he is not absolutely sure in his mind that all is well.

L. E. Wood.

Ilkeston, *January* 3*rd*, 1905.

Hollows on Tramway Rail Treads.

In some of the papers that have been read recently on "Tramway Track Construction," and also in articles contained in your journal, several writers have been surprised at, and cannot find the reason to account for, holes developing on the tread of the tramway rail. Having noticed this, I have watched very closely the wear of these rails, and have

come to the conclusion that this hollowing, or eating away of the tramway rail tread, has nothing whatever to do with the brakes, but is caused by the sparking of the return current (when leaving the motor) taking place between the wheel and the rail.

Any night when the track is not perfectly clean, serious sparking can be seen between the rail and the wheel. I venture to think there is no doubt that this is the cause of the uneven wear of the tread, and could only be remedied or largely prevented by keeping the tramway rail tread absolutely clean and free from "insulating" dirt, so that no sparking takes place at the point of contact between the tramcar wheel and the rail.

Horace Boot,
Consulting and Resident Engineer.

Tunbridge Wells Electricity Works,
January 2nd, 1905.

Nernst Lamps.

I have referred in a former letter to variable voltage and the Nernst in connection with private plant; a similar condition often exists on the public supply mains, and I have in mind at least one case in which the voltage varies over a range of 22½ per cent. of the nominal voltage, the supply being better adapted for arcs having considerable accommodation, as with other lamps electric lighting becomes a mere farce and a considerable nuisance. When a consumer complains about his light, and you find it due to extreme variation, along comes the station kettle-holder with *the* recorder and shows that the voltage is quite uniform. Later more trouble ensues, and, losing faith in the light, the consumer reverts to gas, and I do not blame him.

I think the voltage is often raised to get more current supplied through a distributing system primarily arranged for smaller output. Some are quite frank as to this, others fence and finesse in a disheartening manner.

In the end you will perceive that it is the unlimited variation that causes dissatisfaction, not the increased voltage, and if one could prevail on the supply company to keep the variation within reasonable fixed maxima and minima, then we could approach the supposed defects of lamps with better grace.

R. Pippette.

London, S.W., *January 2nd*, 1905.

There is no doubt that for practical purposes the makers very much over-rate the Nernst lamp. It is almost impossible to run lamps of, say, 220 volts, on a declared pressure of 220 volts. Also the ½ ampere "U" type filament does not give such good results as the old type. The Luna burners I find to give quite as good, if not better, results than the "A" type.

My experience with Nernst lamps extends over a period starting from their introduction. The first ones tested in a London central station gave fairly good results, and it was decided to try them for side street lighting, when these results were more than disappointing, as it was usual for one or two out of six lamps to be wrong, and the lighting became a bye-word, being called "the disappearing lights." These were the "A" type lamps installed at 2½ per cent. over nominal voltage.

We, however, took careful tests and went into the whole matter, with the result that two "B" type lamps were installed in the place of each "A" type at, I believe, 10 per cent. over the nominal voltage; under these conditions many of the burners lasted well over 1,000 hours, and still gave a fairly good light.

When I first came to this town, Nernst lamps had a very bad name, but by carefully considering the local conditions of each lamp installed, and only allowing qualified men to properly fix and attend to them, I have obtained some first-class results.

In one case, three "B" type lamps were installed last November twelvemonth at a local hydro; one failed a few weeks later, and was replaced. These lamps have since run nightly until to-day, when I have just received a report that one has failed, giving over 13 months' run, two of them being in outside lamps.

In another case I installed three "B" type to replace three 32-c.p. incandescents, with the result that the bill for current was halved, and the cost of the lamps paid out of the saving on the first quarter. These three ran for nine months, when they were changed for new burners, as the lights were getting poor.

In another case I have had three Luna burners running since last Whitsuntide, and one has just failed.

There are one or two points to which the makers might give attention:—

1. I have recently had a lot of trouble with the cut-out coils burning out. This was an old trouble, which I thought had been got over. Is there any remedy for this?
2. Contacts in "B" type resistance get corroded and make poor contact. Contacts of burners do not fit properly, being too large for the pins, and these have to be opened out very much.
3. A cheap, substantial, *get-at-able* lamp to stand the weather without requiring an outside cover, might be designed.

In conclusion, I would say, to make Nernst lamps successful:—

1. See that the cut-out works perfectly, that all contacts are clean and fit tight, and that the polarity (if D.C.) is correct.
2. Have the lamp fixed by a competent man, not an apprentice. Let the fixing be firm, or with springs, so that the lamp is not liable to sudden jars.
3. Adjust combined voltage to local conditions, 7½ per cent. to 10 per cent. over declared pressure usually being found most suitable. Where voltage is very variable, use 30-volt resistance instead of 20-volt.

H. Willoughby Lance.

Llandudno, *January 3rd*, 1905.

The Dignity of the Profession.

For an engineer to become proficient in his calling, he must of necessity (unless perchance he be too dignified) take off his coat and other adornments, don his overalls, and indulge in the practical part of his business, and so educate himself in the matter of how each practical part of his business must be carried out.

It, therefore, behoves any intelligent and ambitious jointer—it must be admitted that such jointers are few and far between—to acquaint himself with the more dignified and business side of his calling, during such time as he may have at his disposal, and so qualify himself—and such a thing is not impossible—for an assistant engineer's position. In such a position, and with a reasonable and humane chief, he may even fit himself—marvellous what people without pedigree can learn, isn't it?—for a position as chief engineer somewhere.

And, when he has obtained such a post, he can look back on his past, and say: "Well, I was not trained for an engineer, but I am one, and that I am one is due to my neglect of superfluous recreation, and to my strenuous efforts in the matter of educating myself to such an extent as to qualify myself as one."

Many of our great engineers, particularly those who were born engineers, had they started in life as jointers' mates, would have made the intelligent and ambitious jointers I speak of, and would have aspired to such positions as those of assistant engineers. Luckily for them and the engineering profession, however, they were many of them born of wealthy parents, who were able, with golden glue, to stick their sons half way up the ladder of engineering, while those sons' more unfortunate brothers, *i.e.*, those who were born to be engineers, but not of wealthy parents, were making their first joints, at the end of the bottom half of the ladder. May the jointers climb the ladder, and may we have more jointers like the one appointed, is the wish of—

Impudence.

It may further please "Dignity" to learn that at West Bromwich last month, the station engineer, two shift engineers, and two switchboard attendants resigned their positions simultaneously on account of the way in which they had been treated by the Electricity Committee at this

station. A man who was set to wire the station is now mains superintendent! I mention this merely as an instance of what a committee will do.

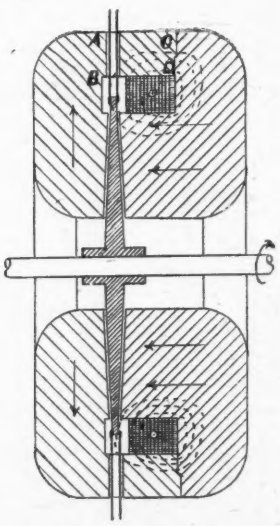
These men will, with Mr. Heron, have the satisfaction of knowing that they did all in their power to protect the interests of those occupying similar positions by refusing to submit to ill-treatment from their committee, and by finally resigning their positions as a last measure. They have upheld the dignity of the profession by sacrificing their posts. All honour to them!

Turbo.

Unipolar Dynamo.

In connection with the unipolar dynamo you have been kind enough to tell me that the flux does not rotate at all, but you have omitted to give any reason for your statement, and at present I can see nothing to prevent it from doing so, other than the eddy currents I mentioned last week. I take it that you admit that the current in the rotating part produces a torque which tends to rotate the flux, and I wish to know what supplies the equal and opposite torque. I feel sure that others are in the same difficulty about this point, so that anyone who explains it will be doing quite a number of people a service.

You also say that even if the flux did rotate there would not necessarily be eddy currents. I see now that my statement about the laminated field system is totally wrong. But, on the other hand, there is certain to be some leakage flux; this flux will take a path which is roughly outlined by the dotted lines in the diagram. Consequently if the whole flux rotates in the same direction as the rotating part of the



machine, the potential difference between A and B will be less than that between C and D, so that there will be a current (not exactly an eddy current in the ordinary sense, as it will never reverse on itself, but will always flow in the one direction) in the iron in the direction C, D, B, A.

Further, I should be obliged if "J. L. D." would explain what he means by saying: "Since there is a practical limit to revolution speed, any attempt to increase the linear velocity and conductor length, by increasing the radius of the rotatory part of the machine, results in pulling down the value of B."

I cannot see what the radius of the rotatory part has to do with the value of the flux density B, except that as the radius is increased the clearance must also be increased, and consequently the reluctance of the magnetic circuit, but this is easily counteracted by increasing the exciting ampere-turns.

W. F. Wolfe.

Preston.

[Our correspondent (whose letter was accidentally omitted from an earlier issue) forgets that magnetic flux is not material, and the forces act not upon the flux, but upon the copper disk and the stationary iron parts; the latter are prevented from rotating by the base plate and foundation, which support them and provide the "equal and opposite torque."

A conductor moved in its own plane in a uniform field is not subject to eddy currents. The leakage shown in the figure would lead to eddy currents if the flux rotated, but this leakage could be practically abolished.—Eds. E.R.]

[Several correspondents have again omitted their names and addresses, and their letters have therefore met the usual fate.—Eds. E.R.]

THE FARADAY SOCIETY.

The Faraday Society held the concluding meeting of the year on December 19th, when, as befitted the occasion, Mr. J. Swinburne, the chairman, announced, as follows, the Council's nominations for this year's officers:—

President—Lord Kelvin.

Vice-Presidents.

Prof. A. Crum Brown,	Dr. Ludwig Mond,
Sir W. Huggins, P.R.S.,	Lord Rayleigh,
Sir Oliver Lodge,	Alex. Siemens, Pres.I.E.E.,
James Swinburne.	

Council.

G. T. Beilby,	Dr. R. A. Lehfeldt,
Bertram Blount,	W. Murray Morrison,
W. R. Cooper,	Dr. W. S. Squire,
Sherard Cowper-Coles,	Dr. O. J. Steinhart,
Prof. A. K. Huntington,	Prof. E. Wilson.

Treasurer—Dr. F. Mollwo Perkin.

It could have been no light task to secure for the Presidency a fitting successor to Sir Joseph Swan, and the Society is to be heartily congratulated on the fact that Lord Kelvin, *doyen* of physicists and electrical engineers alike, has accepted nomination in spite of his years and the burden of innumerable labours. But no obstacles can ever stand in the way of Lord Kelvin's ever-youthful enthusiasm!

The meeting then elected as auditors Mr. L. Gaster and Dr. T. M. Lowry, and proceeded to business. There were four papers down for reading.

M. Adolphe Minet, the well-known French electro-metallurgist, communicated Part II. of his paper on "The Electric Furnace: Its Origin, Transformations and Applications." It was kindly read by Mr. R. S. Hutton, who travelled specially from Manchester for the purpose. The paper, which is fully illustrated, and contains a useful bibliography, is practically a sketch of the historical development of the electric furnace, and cannot be satisfactorily abstracted, especially in view of the fact that the section of most immediate importance, that dealing with industrial furnaces, has yet to come. We may, however, just draw attention to the most novel points in M. Minet's method of classification. The subject is sub-divided as follows:—(1) Laboratory furnaces (1808 to 1886). (2) Industrial furnaces (1886 to 1890). (3) Development of industrial applications from 1890 to the present day.

The present instalment, after some preliminary general remarks on the E.M.F., current densities, and yields, with arc furnaces and resistance furnaces respectively, proceeds to deal in detail with the evolution of the furnaces during the first period. These, in the author's scheme, fall under three well-defined headings:—(1) *Cathode Furnaces:* the electrolysis of fused electrolytes in a containing vessel which forms the cathode. This type was originated on the one hand by Davy (1808—1810) in the electrolysis of the hydrates of the alkalies and alkaline earths, and on the other hand by Napier (1844) who recovered copper from its molten ores—after roasting—on the same principle. (2) *Arc Furnaces.* The arc was discovered by Davy in 1813, but Despretz in 1849 was apparently the first to suggest its use as a heating agent, and Siemens, in 1879, the first who built an actual arc furnace; (3) *Resistance Furnaces:* originated in 1815 by Pepys, who converted a rod of iron into steel by filling a slit in it with diamond dust and heating it to redness by means of an electric current. Although science has no nationality, it is,

we think, a gratifying fact that England was so intimately concerned in the origin of so great an invention as the electric furnace, even if we have failed—perhaps for want of natural opportunities—to hold our own in later years.

The furnaces of this first period contained the germs of all later industrial developments, and at the same time opened out a new realm of knowledge, the chemistry of high temperatures. The work of Berthelot on the synthesis of acetylene, of Siemens, on the fusion of metals, of Clerc, Moissan and Borchers, on the reduction of refractory oxides, and of Davy, Deville and Bunsen, on the electrolysis of fused salts, had only to await the invention of the dynamo, and the economic utilisation of natural forces for the production of mechanical energy, before they could develop into an industry.

The paper by Dr. F. M. Perkin and Mr. W. C. Prebble on the "Electrolytic Analysis of Cobalt and Nickel," contains much useful work, but it is chiefly of interest to the chemist, so need not detain us long here. The aim of the authors was to obtain bright deposits of the metals which should be quantitatively accurate. In the case of cobalt, an alkali phosphate solution, containing a little phosphoric acid, is recommended, while for nickel, the authors suggest a borate solution. The careful student of detailed work of this kind will always bear in mind its possible industrial bearing on the difficult problem of the electrolytic separation of nickel from its ores, which, as Dr. Steinhart pointed out, has by no means been yet commercially solved, in spite of the work of Frasch, Ulke, and others. Such work has also a very direct bearing on some of the obscure difficulties met with by the electroplater, and usually overcome—if overcome at all and not muddled through—by the application of the traditional rule-of-thumb methods of the British workman.

The meeting concluded with an interesting, if somewhat desultory, discussion of the subject of electrolytic detinning, based on two short papers by Mr. F. Gelstharp, entitled respectively "The Electrolytic Preparation of Tin Paste," and "Note on the Electrolytic Recovery of Tin." We think Mr. Gelstharp let slip an admirable opportunity for a really comprehensive paper on this important subject, on which much literature, scattered about in all kinds of periodicals (accessible and otherwise), has been written.

In the chemical method of making tin paste, which, by the way, is used in the manufacture of metallic paper, "feather" tin is dissolved in strong hydrochloric acid and the paste precipitated from the diluted solution by means of zinc. The process is troublesome on account of the acid fumes, while some of the tin is precipitated as bright crystals, which are useless for this purpose. Mr. Gelstharp's process, which is extremely simple, consists in dissolving anodes of tin, roughly cast from commercial ingots, in dilute hydrochloric acid, and depositing the metal in the form of sponge on cathodes of block tin or tinned iron. The current density at the cathode is 270 amperes per square metre. The electrolyte is kept in a state of rapid circulation. The deposited sponge is allowed to grow to a thickness of about 1 in. and is then scraped off the cathodes. It then floats to the top of the bath and is scooped away. It was suggested than an endless band would be a less crude method of removing the sponge than this, which is certain to cause wastage and probably short-circuits. To produce 20 cwt. of paste a week requires a generator giving 1,500 amperes at 8 or 10 volts, and although a current efficiency of only 50 per cent. is attained, the author claims that his process is less costly than the old chemical method; but this contention was not borne out by Mr. Bawtree, who tried to introduce a similar process into a certain firm some years ago, and was unable to do so because the chemical process was carried out by labour costing 15s. a week, and the zinc chloride produced found a ready market.

Mr. Gelstharp's second note discusses a phenomenon that has some bearing on the conditions necessary for electrolytically stripping tin plate. It is generally known by those who have had experience in tin deposition that, in an alkali solution, an ill-conducting film of oxide or hydrate will often form on a clean tin anode, and prevent all further electrolysis. The author suggests the simple expedient of momentary reversal for overcoming the difficulty. The reversal of current produces hydrogen on the anode film, and this reduces that troublesome film to metal, and then all goes merrily. Mr. H. S. Coleman found, however, that all the trouble can be avoided by working the bath at a temperature not higher than 60° C. In the opinions of most of the speakers, the chief difficulty of any detinning process was getting hold of the scrap, but Dr. O. J. Steinhart, in the course of the discussion, gave some very interesting particulars of an electrolytic detinning process that was now economically treating in London seven or eight thousand tons of scrap per annum. The scrap used contained from 1·7 to 2 per cent. of tin, and an extraction of 95 per cent. was effected. Makers of steel are apparently quite glad to get hold of the detinned scrap, so there can presumably be very little tin left behind on it. Here then we have yet another example of an electro-chemical method successfully replacing an older purely chemical process—and thus among other things helping the Faraday Society to justify its existence.

THE WORLD'S FURNITURE.

By AN OPTIMIST.

It is almost needless to remark that whatever may have been the primeval condition of this planet (which, in spite of its fogs, is probably more desirable as a place of residence than any of the others, Venus included) it was, without doubt, even so late as the Stone Age, almost entirely destitute of furniture. Even the little that existed in those days was very expensive, and still more uncomfortable. It possessed, however, the merit of durability—that was, so to speak, its only redeeming feature; a flint razor, for instance, will not carry so fine an edge as a Kropp or a Mappin, but it will preserve it about a million times longer.

Pre-historic man and his wife cannot have lived luxurious lives: imagine a world without bed, blankets or beer, without shoes, shirts or sheets, and worst of all entirely devoid of electric light and tobacco.

There is no evidence that the working man in those days got any wages, and if he did, the savings of a whole continent could not have bought a piano or a sewing machine.

Tens of thousands of years elapsed, and by degrees some sort of furniture was evolved, and consequently the human family succeeded in existing with less discomfort than previously, but even so late as the early part of the nineteenth century of the Christian Era, very little of it came within the reach of the working man, who consequently continued to lead what is commonly called a dog's life, though a dog, born with his clothes on, was generally the better provided for.

A few years previously the steam engine, which for several centuries had been on the look out for a father, discovered first James Watt, and then George Stephenson, with this wonderful result, that in the short space of 50 years the productive power of a man came to be multiplied by five, or possibly ten, and the real business of furnishing the world commenced in earnest.

In the short period covered by the memory of many men now living, the world has been fitted up with railways, steamships, gas, electric light, electric tramways, telegraphs, telephones, penny post, pianos, carpets, lace curtains, motor cars, music halls, and a million domestic accessories of which our great grandfathers knew nothing.

The working man's wages are paid ostensibly in coin, but as a matter of fact, his wages constitute a ticket permitting him to participate in all or most of the advantages of a furnished world.

In other words, his week's wages now provide him with pleasures and privileges which a hundred years ago were denied to kings—he participates, gratis in many cases, and for nominal payments in others, in the result of the piled-up labours of a century—but if it had not been for the steam engine and other labour-saving appliances the pile would have been insignificant, since, without those aids to labour, mankind can scarcely do more than provide themselves with food and clothing.

Every step forward in the furnishing of the world reduces drudgery of the working man and raises the status of

the social scale in which he lives, but neither his own natural intelligence nor the School Board has yet succeeded in teaching him that rapid advancement towards the goal of his ambition can only be attained by further increasing the productive power of the individual, that is to say, by the perfecting of labour-saving appliances, which will enable a man to do a week's work in four days or less.

It is a very curious fact that the labour agitator never objects to the construction of a good road or a railway (which are labour-savers on a gigantic scale), though he will get quite rampant over a lathe with three spindles.

Labour-saving machinery always improves the position of the working man.

No better illustration of this fact can be quoted than that provided by electric tramways. It would appear to a short-sighted labour restricter that if two men by means of an electric car can carry twice the number of passengers at double the speed, that some drivers and conductors must be thrown out of work; the actual facts are that the men employed on tramways have been trebled, their hours of work reduced, and their wages raised. Better still, the *morale* of the man had been improved and their efficiency increased.

The point we are coming to is this, that the real furnishing of the world has only just begun, practically the visible sum total has been done in a hundred years, and now that we have electricity at command as well as steam, it will go forward at a speed hitherto unapproached.

There is so much work to be done before the mechanic can become a gentleman and his daughter a lady, that there is absolutely no place for the idle.

Every man who can work or think will have to do his share, and the greatest share of all must fall to the electrical engineer.

His programme would frighten anyone less eager for work and less self-reliant.

It devolves upon him—

To clean the atmosphere and houses of London by removing all power and heat-producing centres to a distance of 10 or 15 miles from Charing Cross.

To electrify all urban and suburban railways.

To provide electric tramways wherever they are needful, and to make the cars noiseless and weather-proof on both platforms.

To carry the electric light and telephone system into every house.

To provide electric power for all factories.

To conduct the entire street traffic of London and all large centres by electric vehicles.

To fit charging plugs and a telephone to every cab-stand.

To invent an electric housemaid.

To electrify the L.C.C.

To many persons it will appear that the two final items will present the greatest difficulty; possibly so, but already much progress has been made in the reduction of domestic labour; electric lighting, gas fires, and the telephone have produced a marked improvement.

In the course of a few years the motor-driven "vacuum cleaner" will become part of the equipment of every house, with the result that the dwelling place will be clean, not only once a year, but always.

Probably the greatest boon of all will be the electric breakfast table. It will be laid over night, and when breakfast time comes, a touch of the button in mother's bedroom will light the fire, boil the eggs, grill the bacon, cook the kippers, and black the boots, with the delightful result that the present state of high tension which usually exists between mistress and maid will disappear, and morning will become as merry as supper time.

It is with this bright prospect before us that we enter on the year 1905.

A Berlin Celebration.—The Berlin Electrical Engineering Society, founded by Werner von Siemens and Heinrich von Stephan, has completed the 25th year of its existence. The event was celebrated by a gala meeting within the Reichstag Building, the guests including official representatives of the Empire and State, scientific and technical societies of Germany, Holland and Great Britain. Lord Kelvin has been nominated an honorary member of the Society.

NEW ELECTRICAL IGNITION FOR PETROL MOTOR-CARS.

Much interest is just now being aroused in motoring circles by a new form of electrical ignition for petrol motor-cars devised by Mr. A. J. Postans, which has lately been put on the market by the Kennedy Motor Co., Ltd., of Cathcart, Glasgow. The system may be described as a sort of half-way house between the usual system of high-tension ignition with induction coil and accumulators, and the make-and-break magneto ignition. To provide the necessary spark in the combustion chamber at the proper instant, the ignition circuit includes two breaks, one of which—normally open—is furnished at the usual contact maker on the half-speed shaft of the engine, and the other—normally closed—is inside the combustion chamber. When the circuit is closed at the contact maker, the primary current of the accumulator flows and energises an electro-magnet included in the circuit, and by means of the consequent attraction, against the force of a sp ing, of a soft iron armature,

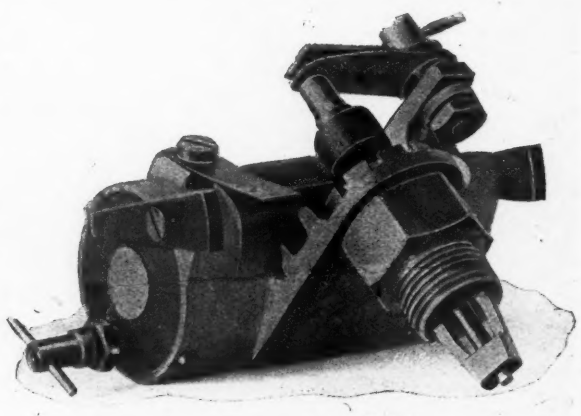


Fig 1

attached to one of the contact pieces of the internal break, the latter is opened and a large spark, due to the so-called "extra current" of the induction circuit, is produced in the combustion chamber and ignites the charge, a series of such sparks occurring during the time the external break is closed. The accompanying illustrations depict the apparatus very clearly, fig. 1 being a general view of the complete device, fig. 2 a plan, fig. 3 an elevation, fig. 4 a part sectional elevation, showing the arrangement of the sparking plug which forms the

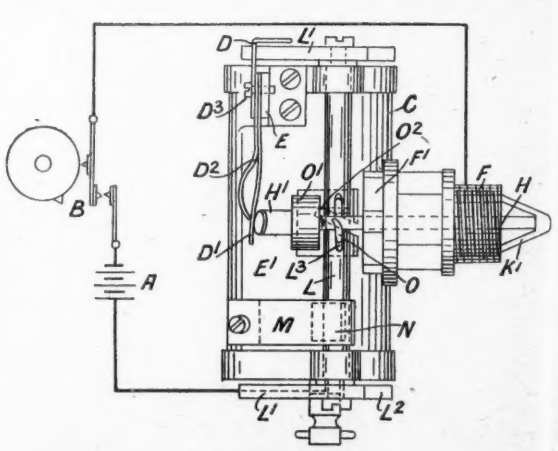


Fig. 2.

internal break, and fig. 5 a diagram showing the arrangement of the contact maker or external break, and its connections for a four-cylinder engine. From fig. 2 it will be seen that the circuit includes a battery A, consisting usually of four two-volt accumulators, one terminal of which is in connection with a terminal on a small coil C, and the other "earthed" through a contact maker B, the plug F being also earthed. The other end of the coil, which surrounds a soft iron core C^1, is connected by the arm D to the platinum-pointed spring piece D^1, clamped between the arm and a bracket E fixed to, but insulated from, the iron casing E^1 enclosing the coil, and backed by a second spring D^2, which acts as a yielding stop to limit the travel of the movable electrode H. The ignition plug F is clamped to a projecting part of the casing E^1 by means of the nut F^1, and is threaded so that it can screw into the combustion chamber in the usual way. It has a central plug G (fig. 4) of insulating material, through a hole in

which passes a rod H of hardened steel. On one end of this rod is adjustably fixed a contact piece terminating in a steel ball H^1, which abuts against the platinum point of the spring D^1, and is urged forward by it so as to normally hold the other end of the rod H in contact with the bridge piece K^1 formed integrally with the body of the plug. The springs D^1, D^2 are so pivoted by a set screw D^3 between the arm D and the bracket E that they may be swung round and the sparking electrode instantly removed or replaced when desired.

The armature of the electro-magnet or coil C consists of a soft iron or steel rod L journalled in the casing E^1, and having fixed at right angles to its ends and in the same plane with each other and the rod L two bars or fingers L^1 of similar material. These fingers, which are long enough to reach beyond the centre of the iron core

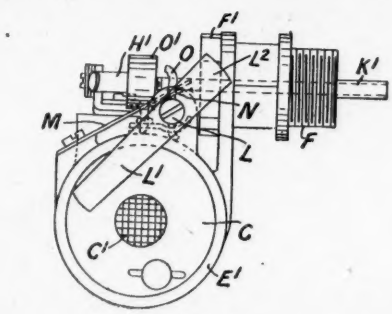


FIG. 3.

C^1 and are formed at their other ends with balancing extensions L^2, are normally held displaced to one side of the core by means of a spring M fixed on the coil casing E^1. The spring M engages with a reaction piece N fixed on the armature rod L; in a slot L^3 in the rod is pivotally mounted a pin O, one end of which projects upwards behind a collar O^1, made of insulating material and fixed on the rod H. The other end of the pin O travels in a cam slot O^2 (fig. 4) formed in the casing E^1. The slot is shaped so as to constrain the point of the pin O which encounters the collar O^1 to travel in a substantially rhomboidal path during the movement of the armature of the electro-magnet, with the result that when the armature is attracted, a positive rotation is imparted to the collar O^1, and therefore to the rod H, the object being to equalise any wear on the inner end of the latter. The eccentric engagement of the pin O with the collar O^1 causes the latter, and with it the electrode H, to turn through a small angle each time the electro-magnet is energised, the regular wear of the sparking surface thus secured not only increasing the life of the electrodes but also the certainty of their action. The arrangement of the spring M and reaction piece N is such that the armature is able to oscillate on either side of its normal position of rest, while the balancing of the armature renders it practically unaffected by engine vibrations, and therefore minimises the chance of a misfire resulting from such vibration.

Passing now to the action of the apparatus, when the contact-maker B is open, the sparking electrodes H, K^1 are held in contact by the spring D^1, but as soon as contact is made at B, the electro-magnet is energised, the fingers L^1 of the armature are attracted towards the centre of the core C^1, thereby turning the rod L in its bearings, so that the pin O, pressing against the collar O^1, forces the electrode H

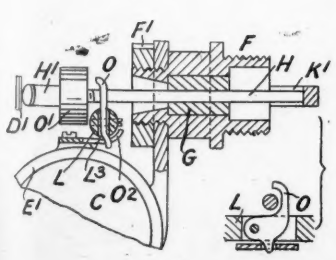


FIG. 4.

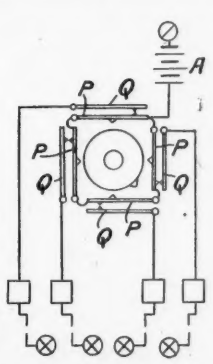


FIG. 5.

backwards against the spring D^1, and causes a break in the circuit at the inner end of the plug, resulting in an enormous spark at that point due to the so-called "extra current." The electro-magnet again becoming de-energised, the spring M returns the armature to its normal or unattracted position, and the spring D^1 tends to close, and if there has been no ignition of the charge in the cylinder, will close the break at the electrodes H, K^1, and the electro-magnet will again become energised if contact is still made at B. The time of contact at B can be varied within wide limits, but even the least time of contact obtainable by mechanical means is long enough to produce a series of "breaks" and "makes," and, therefore, a series of sparks at the electrodes H, K^1. As soon, however, as the combustible mixture has been ignited, the resulting pressure in the cylinder forces the rod H outwards against the reaction of the spring D^1, and holds the electrodes H, K^1 out of contact long enough to keep the circuit broken at H, K^1 until it is again broken at the contact maker B. In the case of two, three, or four-cylinder motors, each cylinder is provided with its own electro-magnet and plug, fig. 1, worked off the one battery, through a special contact maker, that for a four-cylinder engine being shown diagrammatically in fig. 5. One element P of each of the contacts is connected to one of the poles of the battery A, and each element is arranged to be successively displaced by a moving part of the engine so as to be brought into contact with its fellow element Q, each of which is connected to one end of its corresponding electro-magnet. There is thus no high tension wire, the only wires in a four-cylinder engine being a short one earthing one terminal of the battery, another short one from the other terminal of the accumulator to the contact maker, and one from each of the terminals of the latter to the electro-magnets.

The size and power of the spark, which has to be seen to be realised, is such that the complete charge in the cylinder is fired more quickly than usual, resulting in a more rapid explosion; while, apart from this, one of the great advantages of the system is its ability to furnish a series of sparks at low as well as at high engine speeds. There is no escape of explosive mixture at the movable electrode, which is a nice fit and has a $\frac{3}{4}$-in. bearing in the body of the plug. The electrode is so made that it can easily be adjusted to allow for any wear, while it can be renewed at the cost of a few pence. Oil or sooty deposits on the inner end of the plug do not appear to have any effect on its action, nor does the proximity of the coil to the explosion chamber of the engine cause it to be adversely affected by the heat, it consisting of seven layers of stout wire well insulated. The device, which is exceedingly compact, as will be seen from the fact that the illustation, fig. 1, given herewith shows it nearly full size, has, we understand, already been adopted by one large manufacturer of motor-cars.

BUSINESS NOTES.

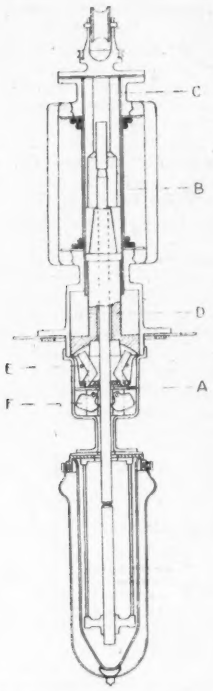
An Exhibition at Islington.—The Lighting Committee of the Islington Borough Council propose holding an Electrical Exhibition at the Hornsey Road Baths, from February 27th to March 11th inclusive, provided that the Council at its meeting to-day approves the scheme. We understand that the three largest Baths will be utilised for the Exhibition, which will include not only machinery in motion and all kinds of electric lighting, heating, cooking and power appliances, but also electrical novelties of all kinds, electric fountains, illuminations, &c., while the men's large first-class bath will be used for swimming and diving entertainments, model yacht races, trips on electric boats, musical entertainments, &c., the intention being not only to attract intending consumers but also the general public, thereby greatly increasing the value of the Exhibition to the exhibitors as a medium of advertisement.

A Large Shipment of Electrical Machinery to Japan.—Last week a special train consisting of 42 wagons left Messrs. Dick, Kerr and Co.'s Preston Works, carrying 250 tons of electrical machinery, being shipped in connection with that company's contract for the complete equipment of the Tokyo Denki Tetsudo Kabushiki Co.'s tramways. This tramway system when finished will cover over 60 miles of line, and operate some 250 cars. The complete installation is being carried out by Messrs. Dick, Kerr & Co., under the supervision of a staff of their engineers, and it is surprising to learn that the only effect the war has had on the progress of the work is in connection with the transportation of the machinery from Yokohama to Tokyo, the railway being congested with war material.

Westinghouse Turbine at St. Louis.—A noteworthy incident of the morning following the close of the St. Louis Exposition was the formal shut-down and inspection of the 600-H.P. Westinghouse steam turbine generating unit in the Palace of Machinery after a continuous run of over 3,962 hours—a performance which has had no parallel in steam turbine history. This machine was started on its long run at 9.20 a.m. on Monday, June 20th, shortly after its installation at the Fair, and was stopped at 11.32 a.m. on Friday, December 2nd. During the five and a half months that the set was in operation it supplied current for light and power throughout the Westinghouse exhibits in the Palaces of Machinery, Electricity and Transportation. When the engine was stopped, it was found to be in perfect condition, and there were no signs of wear, the bearings still retaining the tool marks as they had come from the shops. There have been at least two instances on record in America in which piston engines have been run continuously for about the same length of time as the Westinghouse turbine. The remarkable feature of the turbine run was the maintenance under load of a speed of 3,600 r.p.m. for such a long period. From 8.30 a.m. to 10.30 p.m. the load carried throughout the Exposition varied from 25 per cent. underload to 25 per cent. overload. The total number of revolutions was 855,792,000.

A German Combine. — It is reported that leading German manufacturers of electric bells, indicators, and similar articles, intend to form a combine for the purpose of raising the prices of these articles, the probable cause being the increase in the price of raw materials.—*Helios.*

The "Ark" Arc Lamp.—With reference to the notice of the Regina arc lamp, which appeared in our issue of December 23rd, Messrs. Johnson & Phillips write pointing out that some of the features which are claimed as novel have been in use for some years past in their well-known enclosed "Ark" lamp. This especially is the case with the total enclosure of the actuating mechanism as well as the carbons. Another feature which has always been incorporated in this lamp is the combined contact and cut-out device. Four contact pieces (F) rest against the top carbon by gravity, and when a certain amount has burned these fall into a groove in the carbon, effectively preventing overfeeding and consequent damage to the lower carbon holder. Recent improvements



SECTION OF "ARK" LAMP.

in this lamp include a spring suspension for the inner globe, which very greatly increases the duration of the carbons, and at the same time facilitates the removal of the globe for trimming purposes. The cost of production is very low, owing to the extreme simplicity of the Ark. The whole of the mechanism is accessible by unscrewing the casting against which the top of the inner globe rests. The armature D, with clutch E attached, will then drop out. These are the only working parts. Street lighting is a crucial test for arc lamps, and one which many enclosed lamps are unable to pass satisfactorily; Messrs. Johnson & Phillips are, therefore, to be congratulated on their successes in this direction at East Ham, Sutton Coldfield, Calcutta, Shanghai and other places.

Trade Announcements.—Messrs. Fuller, Macleod and Co., Ltd., who recently transferred their stock of, and connection in, electric light accessories to Messrs. Falk, Stadelmann & Co., have now removed their offices to Norfolk House, Laurence Pountney Hill, E.C., and their stores to 115, Cannon Street, E.C. The firm will henceforth devote special attention to Hellesen's dry cells, their patent heavy type electric bell, electric motors and dynamos, also electric ignition apparatus for motor-cars.

Messrs. Bergtheil & Young notify that, for the more convenient working of their business, they have converted it into a limited company, under the name of "Bergtheil & Young, Ltd." The company took over the business as from January 1st. Messrs. Arthur and Edward Bergtheil and H. Wilson Young have become directors of the company, and the management will be as heretofore.

Messrs. Chas. F. Quicke & Co., electrical, mechanical and consulting engineers, have removed their offices and stores to 315, Euston Road, N.W.

In consequence of the growth of the National Telephone Co.'s metropolitan business, it has been found necessary to entirely reorganise its office arrangements in London, and as from 1st inst. all the business which has hitherto been conducted locally by six district offices will be concentrated at the new metropolitan offices, Salisbury House, London Wall, E.C. All written communications should be sent direct there.

Imports of Foreign Electrical Machinery.—As with telegraph cables, there has been a rather more active state of affairs prevailing in the importation of foreign electrical machinery into this country during recent months. Thus the imports during November last attained a value of £44,529, as contrasted with only £37,530 in November, 1903. For the first 11 months of the year, the returns show a total of £521,590, as against only £505,268 in the corresponding 11 months of 1903.

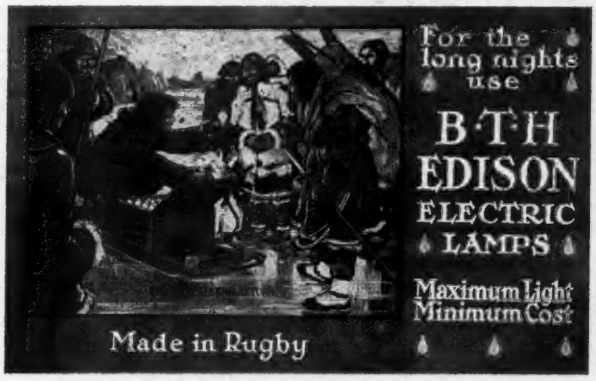
Catalogues, Calendars, &c.—The ALLIANCE ELECTRICAL CO., LTD., of 157, Regent Street, W., have forwarded to us a copy of their booklet, entitled "A Treatise on Electrically Direct-driven Spinning Frames, Unit System." We recently referred to the above matter in our columns, and have no doubt that the pamphlet will interest those connected with the cotton-spinning industry.

The HART ACCUMULATOR CO., LTD., of Marshgate Lane, Stratford, E., have forwarded us a handy blotting pad, which will serve the double purpose of keeping the company's well-known productions in mind and prove a useful acquisition in the office.

From MESSRS. HOLDEN & BROOKE, LTD., of Sirius Works, West Gorton, Manchester, we have received leaflets of their well-known 1903 patent steam trap, their patent "P.S." valve, and the Pattern "S" one movement injector.

A new illustrated price list of high speed electric drilling machines has been published by MESSRS. KRAMOS, LTD., Bath. The "Midget," "Slick," "Runthru," and "Dandy" types are shown and detailed.

We recently referred (ELECTRICAL REVIEW, December 23rd)



AN ARTISTIC POST-CARD.

to an artistic advertising effort on the part of the B.T.-H. Co., which took the form of a coloured pictorial card. We are now enabled to reproduce this on a small scale, and any of our readers who may be interested in the matter can doubtless obtain a copy of the original on application to the company.

MESSRS. T. POTTER & SONS, of 44, South Moulton Street, W., are sending out to their friends a small pocket diary for the current year.

A convenient pocket-book and diary for 1905 has been issued by MESSRS. A. W. PENROSE & Co., electrical engineers, 109, Farringdon Road, E.C.

MESSRS. ROBERT A. THOMPSON & Co., LTD., of 5, Tudor Street, E.C., colonial publishers, have sent us a capital perpetual wall calendar.

Once again we have been favoured by MESSRS. NALDER BROS. and THOMPSON, LTD., of Queen Street, E.C., with one of their convenient and businesslike wall calendars for 1905.

MESSRS. MILLINGTON & EVERITT, electrical engineers, Cambridge, have sent us a leaflet of their M.M. patent ignition indicators for use on motor-cars and cycles; the device is claimed to show at a glance whether ignition failures are due to mechanical or electrical causes.

From the UNDERFEED STOKER CO., of Coventry House, South Place, Finsbury, E.C., we have received an advance copy of a new catalogue, giving all particulars of their speciality and numerous tests of its capabilities. This booklet is profusely illustrated.

Mr. PETER ASHCROFT, of Old Hall Street, Liverpool, has issued his "Liverpool Yearly Coal Trade Review, 1904."

The ADNIL ELECTRIC CO., of 6, Victoria Avenue, Bishopsgate Street Without, E.C., have forwarded us a price list of their automatic overload alarms, for use with dynamos, motors, batteries, &c., together with particulars of the same.

MESSRS. ARCHIBALD SMITH & STEVENS, of Janus Works, Queen's Road, Battersea, are circulating an illustrated brochure, which contains matters of special interest to users of electric lifts, of which the firm make a speciality. The electric *v.* hydraulic lift is briefly discussed, and the good points of the former are detailed at some length.

MESSRS. WITTY & WYATT, LTD., of 88, Leadenhall Street, E.C., send us an excellently illustrated booklet dealing with the numerous applications of Carey's magnesia, for which product they have been appointed sole selling agents in this country.

Quite unique among all the calendars and desk companions that have been received by us for 1905, is the desk calendar of the ARMORDUCT MANUFACTURING CO., LTD., of Farringdon Avenue, E.C. A separate memoranda slip is provided for each day, at the head of which the date is boldly printed; the whole of these slips are conveniently raised on a neat and substantial polished-wood base. The slips are not torn off daily, but are passed over strong wires, and preserved as a record of all the notes made during the year.

An exceedingly neat wall calendar has been sent to us by MESSRS. HORSEY & SON, printers, of 151, Queen Street, Portsmouth.

MESSRS. J. HALDEN & Co., of Great Chapel Street, Victoria Street, S.W., have issued a new wall calendar with a separate sheet for every month, these sheets being interleaved with lists descriptive of their various drawing instruments and apparatus.

MESSRS. JACKSON BROS., electrical engineers and contractors of Broadway, Plaistow, E., have sent us a hanging wall calendar with monthly sheets, each sheet having a small complete calender for the year at the foot.

MESSRS. MAVOR & COULSON, LTD., of Mile End, Glasgow, have placed in our hands one of their wall calendars for the current year, with tear-off monthly sheets.

MESSRS. PARMITER, HOPE & Co., of Hulme Electrical Works, Manchester, have forwarded to us a very neat hanging wall calendar with changing dates, which will do for all time.

MESSRS. W. H. WILCOX & Co., LTD., of Southwark Street, S.E. are keeping their name before the eye of the trade by means of a new date remembrancer for 1905.

Acton.—Messrs. L. Hermes & Co., of 29, Uxbridge Road, Ealing, have the contract for the electric lighting installation at the Acton District Council's offices.

Dissolutions and Liquidations.—The Industrial Storage Battery Syndicate on December 28th resolved to wind up, as it cannot by reason of its liabilities continue the business. Mr. W. W. Futcher, 103, Gresham House, E.C., was appointed liquidator, and creditors should send particulars of their debts to him by February 3rd.

The Derbyshire and Nottinghamshire Electric Power Syndicate, Ltd., is winding up voluntarily, with Mr. G. D. Prince, 5, Great George Street, Westminster, as liquidator. This is in consequence of the transfer of the assets and business to the Derbyshire and Nottinghamshire Electric Power Co., Ltd.

A meeting of Peto & Radford, Ltd. (incorporated 1897) is to be held on February 6th at 55, Hatton Garden, E.C., to hear an account of the winding up from the liquidator (Mr. W. Peto). A similar meeting of the P. & R. Storage Battery Co., Ltd., is to be held at the same place on the same day.

Messrs. Newman Wilkinson & J. E. Mellor (Newman Wilkinson and Mellor, electrical engineers, 43, Mincing Lane, E.C.) have dissolved partnership. Mr. Wilkinson will attend to debts.

The Electrical Fittings Co., Ltd., on December 30th passed a resolution for voluntarily winding up, and appointed Mr. J. D. Pattullo, of 65, London Wall, E.C., as liquidator, Mr. Pattullo having been already appointed receiver on behalf of the debenture holder. A meeting of creditors was called for yesterday at the company's offices, 38, Conduit Street, W.

Bankruptcy Proceedings.—The first meeting and public examination of W. & E. Sumner, electrical and mechanical engineers, Liverpool, will take place on January 13th and 19th at Liverpool.

Electricity in Collieries.—The Alliance Electrical Co., Ltd., have completed the conversion to electrical driving of the haulage gears, pumping and ventilating machinery at the Delaney Collieries and Quarries. The pits are also lighted by electricity from a separate lighting dynamo, the current for lighting being supplied at 110 volts, and the power plant working at 440 volts. The output of the machinery installed totals to about 120 B.H.P.

The Transvaal.—The value of the electric cables, wire and fittings, imported into the Transvaal during the nine months ended with September last is returned at £54,000, as compared with only £53,000 in the corresponding nine months of 1903.

"Maxim" Arc Lamps.—We are informed that after testing 12 different makes of arc lamps, the Underground Electric Railways Co. of London, have placed an order with the Sir Hiram Maxim Electrical and Engineering Co., for a very large number of "Maxim" D.C. traction circuit arc lamps. These lamps are to burn five in series on 550 volts direct current, and are provided with self-contained line, and substitutional resistances, and automatic cut-out, and an isolating switch by which one lamp can be trimmed or examined while the other four are burning. The mechanism chamber is completely separate from the resistance, and the overall length of the lamp is only 28 in. A full trim of carbon 12 in. 12 mm. top, and 5 in. 12 mm. bottom, is stated to last 90 hours with single enclosure globe, and the carbon left in the top holder is just long enough for the bottom holder for re-trimming. The isolating switch is operated by means of a key inserted through a water-tight self-replacing latch in the case.

Ship Lighting.—The order has just been secured by Messrs. W. C. Martin & Co., of Glasgow and London, for the electric lighting of the 30 new steamers building for the passenger traffic on the Thames for the London County Council. They have also contracted with the Caledon Shipbuilding and Engineering Co. (Dundee) for the lighting of the passenger steamer they are building for the General Steam Navigation Co., Ltd., London, and with Messrs. Gourlay Bros. & Co., Ltd., Dundee, for the lighting of the two steamers they are building for Messrs. Charles Barrie & Son. Another order placed is that for four steamers building by the Clyde Shipbuilding and Engineering Co., Ltd., for the Danish Russian Steamship Co., Ltd., Copenhagen.

Grimsby Installations.—Owing to the satisfaction given by the installation of electric light and power for sterilising and cautery purposes in the operating theatre of the Grimsby and District Hospital, the management committee has given a contract for the lighting of the new wing of nurses' bedrooms and waiting hall to Mr. D. J. Dolby, of Grimsby, its former contractor. Mr. Dolby has recently completed a contract for the lighting and heating of the Union of London and Smith's Bank, Ltd., and manager's residence. The installation is laid in solid drawn steel conduit. Some of the fittings were supplied by Messrs. Henry, Ltd., London, in their latest designs in wood.

Norway.—The Norwegian Government proposes placing a duty of 50 kr. per kg. on insulated electric cables, which have hitherto entered free. The duty on railway and tram cars, which at present amounts to 15 kr. per kg., is to be raised to an *ad valorem* duty of 12 per cent.—*Export Zeitschrift für Electrotechnik.*

Ball Bearings.—The Lahmeyer Electrical Co., Ltd., whose improved patent ball bearings, which they are fitting to their motors, were recently mentioned in our columns, ask us to state that these ball bearings were manufactured by the "Deutschen Waffen & Munitionsfabriken, Berlin," the agents in this country of whom are Messrs. L. Loewe & Co., London.

Book Notices.—"Die Asynchronen Drehstrommotoren, ihre Wirkungsweise, Prüfung und Berechnung." By Dr. Gustav Benischke. Brunswick: Fried. Vieweg & Sohn. M. 6.

"Atti della Associazione Electrotecnica Italiana." Vol. VIII., July, August, September and October. Rome: Sede Centrale, 397, Corso Umberto I.

"The Fan: including the Theory and Practice of Centrifugal and Axial Fans." By C. H. Innes. Manchester: The Technical Publishing Co.

"The Construction of Cranes and other Lifting Machinery." By E. C. R. Marks. Third edition, revised. Manchester: The Technical Publishing Co. 3s. 6d. net.

"The Beginner's Guide to the Lathe." By Percival Marshall. *The Model Engineer* Series, No. 25. London: Percival Marshall and Co. 6d. net.

"Fire Tests with Automatic Sprinklers." No. 87. Type submitted: Albion Sprinkler Co.'s. London: The British Fire Prevention Committee, Inc. 2s. 6d.

Messrs. Longmans & Co. have in the press a work on "'N' Rays," by R. Blondlot, professor in the University of Nancy, translated by J. Garcin. It is a collection of papers communicated to the Academy of Sciences, with additional notes and instructions for the construction of phosphorescent screens.

"The Letter of Petrus Peregrinus on the Magnet, A.D. 1269." Translated by Brother Arnold. Introductory notice by Brother Potamian. New York: McGraw Publishing Co. $1.50.

"Mathieson's Handbook for Investors for 1905." London: F. C. Mathieson & Sons. 2s. 6d. net.

"Municipal Finance for Students." By A Municipal Accountant. London: Gee & Co. 2s. 6d.

LIGHTING AND POWER NOTES.

Arbroath.—The negotiations which have been so long pending between the T.C. and the Empire Electric Light Co. for the taking over of the E.L. prov. order, have now been satisfactorily arranged. It is understood that the company has accepted the terms recently submitted by the Committee.

Argentine.—The Commissioners appointed by the La Plata Government and the River Plate Electricity Co. to assess the company's property with a view to liquidating the share held by the Government, advise that the company pay $47,763 for machinery, &c., and $179,847 for land and buildings. The Government is to pay $158,236 for lighting accounts, leaving a balance of $89,575.

The *Review of the River Plate* states that the director of public lighting has drawn up a draft contract for the public electric light service in the city of Buenos Ayres. In his report he states that the city now pays $17,674 m/n for the 760 arc lamps in service, which works out at $23.26 per lamp per month. If in place of this the city accepts the offer of the German Electric Light Co. to pay $0.035 gold per KW-hour, it would be, with 0·525 KW.-hour per lamp, and 39 hours a month, equal to 172,725 KW.-hours per month, costing $6,045 gold, or $13.74 paper per lamp. The actual service for maintenance costs in the Municipal stations per lamp per month is:—Carbons $2.40, labour $2.50, repairs $1.20, night service $0.80. Total per lamp $6·90. This would bring the total cost per lamp up to $20.64, as against $23.26 now paid, and would represent an economy of $24,020 per year.

Barking.—The U.D.C. has made application to the L.G.B. for permission to borrow £8,500 in respect of extensions to mains, &c, in connection with the electric lighting station.

Barnstaple.—A loan of £3,000 for electric light extensions has been applied for by the T.C.

Bradford.—The Electricity Committee of the T.C. has considered for a second time the report of the city electrical engineer, Mr. A. S. Blackman, on the subject of the distribution of electricity, and finally adopted it. Mr. Blackman recommended—(1) that the tramway distribution cables should be augmented as soon as possible upon the present system of supply, with the exception of the Leeds Road and Stanningley and Manchester Road routes, for the supply of which sub-stations fed by high tension three-phase current at 6,000 volts pressure should be employed; (2) that mains extensions outside the area supplied by the existing consumers' network should be carried out upon the three-phase system for both transmission and distribution, and that the introduction of this system should be made at once, commencing with Wakefield Road; (3) that the high tension current should for the present be generated by means of plant installed in the works for converting the low tension continuous current. The summary of the contemplated expenditure was: For the tramways distribution, including a spare 500-KW. feeder laid into each sub-station, £26,185; for high tension

feeders for general supply to Wakefield Road, Park Avenue and Otley Road, £4,432; for transforming plant at the works, £10,250; total, £40,867.

Beckenham.—The five years' lease of the Beckenham electric light works, now rented by the B.I. and H.C., will expire in November of this year (1905), and at its last meeting the Council had before it a motion to consider the advisability of extending the lease to the same company for another period. The mover of the resolution stated that from figures furnished, it appeared that the works were not remunerative, and as they did not know whether the company would accept the lease for a further period, he had moved that resolution in order to bring the matter to a head one way or another. The motion was defeated, and the matter left in abeyance.

Bury (Lancs.).—The T.C. has reduced the price of energy to the Corporation tramways from 1·5d. per unit, making the price 1·4d. per unit from October 1st to December 31st, 1·3d. per unit from January 1st to March 31st, and 1·2d. per unit from April 1st to September 30th.

Chester-le-Street.—After a lengthy discussion it was decided by the T.C. that the resolution adopted on July 14th last, opposing the application of the Durham Electrical Power Distribution Co., Ltd., to the B. of T. for a prov. order to supply electrical energy for public and private purposes within the Council's district, be rescinded, and the consent of the Council be given to the company's application.

Continental Notes.—The municipal authority at Gleisdorf, Austria, has decided to ask offers for lighting the town by electricity.

At Plasencia, Spain, the Municipal Council is calling for tenders for a concession for the electric lighting of the town for 12 years. At Navia it is proposed to utilise available water-power for generating electricity for lighting the town, and also Doal, El Egpin, Ortiguera, and Puerto de Vega. A company is being formed to carry out the project.

Tenders are to be invited for the lighting of Rellingen, Germany.

Dartford.—A loan of £300 for the purpose of free wiring has been applied for by the U.D.C.

Dover.—Electricity is to replace gas in the whole of the Corporation buildings. The number of lights to be utilised is 236, and the wiring, &c., will cost £178 10s.

Dublin.—The Committee of the Whole House on the question of the electric lighting scheme has submitted to the meeting of the Corporation a recommendation that the payment of £449 19s. 11d., as being due to Mr. Hammond under his agreement as consulting engineer, be discharged in accordance with the recommendation of the Lighting Committee.

Duluth (U.S.A.).—A power canal to drive electrical machinery of 30,000 H.P. is to be started immediately. The needed funds, amounting to £710,000, are provided by New York, Boston and Philadelphia bankers.

Dunfermline.—The relations between the Corporation and the Fife Electric Power Co. seem to be in a delicate stage, an agreement as to the terms regarding the cables and opening up of the streets not yet having been come to.

Earsdon.—The East Holywell Coal Co. has intimated that it cannot supply the Urban Council with electrical energy for lighting purposes at East Holywell.

Exeter.—A conference is to be held between the Tramways and Electric Lighting Committees on the subject of the electrical equipment of the tramways, and to make arrangements for the supply of energy.

The electrical engineer reports that the total connection to the mains of lamps, motors, radiators, &c., has now reached an amount equivalent to 36,572 8-C.P. lamps.

Frizington.—The Arlecdon and Frizington U.D.C. has requested Mr. Rook, electrical engineer of Workington, to report on the cost of an E.L. scheme for the district.

Hanwell.—Mr. H. S. Russell has been engaged to report on the general question of the electric lighting of the district, including the cost of the necessary mains, &c., also the financial aspect of the proposals made by the Metropolitan Electric Supply Co. and the Ealing Town Council, at a fee of 20 guineas.

Haslingden.—The B. of T. has informed the T.C. that it has deferred the revocation of the electric light order for six months.

Kingston-on-Thames.—At a recent T.C. meeting, it was resolved to support a conference of local authorities interested in opposing the Administrative County of London and District Electrical Power Co.'s Bill in the ensuing session of Parliament.

Lancashire Power Co.—This company has completed its generating station at Outwood, and is laying trunk mains in the Rossendale Valley to Swinton and Pendlebury, and to the Wigan colliery district.

Leeds.—When the proposed extension of arc lighting in the centre of the city is carried out, some 650 1,000-C.P. lamps will be installed.

London.—ISLINGTON.—The B.C. Lighting Committee has entered into an agreement with the County of London Electric Supply Co., under the provisions of the London Electric Lighting Areas Act, 1904, for the transfer of parts of Finsbury and Islington in which the contracting parties were authorised to supply energy, and in which they had laid mains. By the terms as settled, the Council pays to the company in consideration of capital expenditure, and three years' purchase of annual revenue £2,058, while it will receive from the company a sum of £194 only. The difference is explained by the fact that the company had a comparatively extensive system of mains and pipes in those portions of Finsbury which the B.C. takes over, while in the portions of Islington to be surrendered the Council has invested but little. The transfer brings to the B.C. an additional annual revenue of £382. The Finance Committee reports having passed the following estimates:—£1,745 for arc lighting and provision of conduits; £500 for an electrical exhibition to be held at Hornsey Road Baths; £385 for the proposed purchase of seven transformers, maximum indicating devices, &c.; £320 for painting and cleaning the generating station.

Newquay.—Arrangements for the installation of the electric light are now complete. The site of the station is practically settled, and it is anticipated that very soon the necessary initial steps will be taken.

New York City.—Up to December 23rd the controversy as to the excessive charges for lighting the city was unsettled. The Interborough Rapid Transit Co. has made a suggestion to provide energy for lighting purposes, at a reduction of 40 per cent. on existing prices. Arc lamps of 2,000 C.P. now cost the city £30 2s. per lamp per annum.

Niagara Falls.—The latest scheme for power development along the Niagara frontier has for its foundation the turning of the waters of the Chippewa River, making the future outlet Lake Ontario, instead of the Niagara River. If this is carried out, advantage can be taken, for power purposes, of the 300 ft. drop between the level of the Niagara River above Niagara Falls and the level of Lake Ontario. The available opportunities above the falls for utilising the forces of the combined lakes are stated to be practically exhausted, while at the same time only a small fraction of the estimated horse-power of the cataract has been taken up.

Penrith.—There was great opposition at the L.G.B. inquiry into the U.D.C.'s application for a loan of £6,850 for electric light purposes. At the outset the validity of the proceedings was questioned, it being contended that the matter had never been brought before the Council. On behalf of the Council it was stated that its hands had been forced by the application for electric lighting powers made by speculative companies, and that the scheme had been brought forward to protect the ratepayers. For the opposition a petition signed by 635 ratepayers to the effect that the scheme was unnecessary and unprofitable, was put in, and evidence against the scheme was given by seven persons.

Penzance.—Considerable interest is being manifested at St. Michael's Mount, the historical residence of Lord St. Levan, being fitted with a complete electric light installation. The generating plant will consist of two engines of the internal combustion type, dynamos, and a large storage battery. The installation is being put down by Messrs. Drake & Gorham, Ltd., Westminster. The engines will, in addition, supply the necessary power for working a cable tramway used for bringing goods up an underground tunnel from the sea-level into the Mount. A special system of concentric water-tight conductors has had to be designed, which will give absolute immunity against fire risks, as the walls are often soaked with spray or wet from condensation.

Perth.—At a meeting of the Electricity Committee of the T.C., a letter was submitted from the Secretary for Scotland giving his consent to the Council borrowing sufficient money for the additional plant to be erected at the electricity works for the electrification of the tramways.

South Staffordshire.—A report just issued by the South Staffordshire Mines Drainage Commissioners, shows that the Commissioners are spending £20,000 on electrically-driven surface pumps for mines drainage purposes.

Sunderland.—Eight tenders for a new cooling tower have been received by the Electricity Committee, ranging from £485 to £850. It is proposed to erect the new tower at the Hylton Road power station.

Taunton.—The Assessment Committee recently had under consideration the case of the assessment of the Taunton Electricity Works. Previously the depôt and the machinery were rated at £635 gross, and the mains, &c., at £330 gross, the rateable values respectively being £343 5s. and £180, making a total of £965 gross and £523 5s. rateable value. The Assessment Committee then raised the amount to a total of £2,500 gross, and £1,880 rateable value, an increase of £1,535 on the gross, and £1,356 on the rateable value. The Town Council claims that £1,000 is a fair figure for assessment, but the Assessment Committee has now placed it at £1,130, and expressed its determination to adhere to this amount. This means a reduction of £750 on its former estimate of the rateable value.

Todmorden.—The T.C. has fixed the price of electricity for private lighting at 5d. per unit.

(Continued on page 25.)

THE AMSTERDAM-HAARLEM TRAMWAYS SYSTEM.

About five years ago there was constructed in the city of Haarlem, by a local Dutch company, an electric tramway system—the first in Holland. This system included a belt line about the city of Haarlem, with two suburban branches, one running north to Bloemendal, a thriving residential suburb, and another west about five miles to Zandvoort, an important seaside resort frequented by the people both of Haarlem and of Amsterdam.

View on the Amsterdam—Haarlem Tramways.

Haarlem itself is a city of 65,000 inhabitants, and is a very pleasant residential place, where many of the business men of Amsterdam live. The distance between the boundaries of the two cities is 10 miles. It appeared to a number of people that an electric line connecting the two should be a paying enterprise, and several years ago a concession was granted for such a line, but the route was rather roundabout, and finally the Holland Steam Railway Co. secured control and prevented the construction of the line. In 1901, however, Messrs. Anderhagen & Neumeyer, of Amsterdam, took the preliminary steps towards securing a new concession over the direct Government High Road connecting the two cities and running parallel with the steam railway.

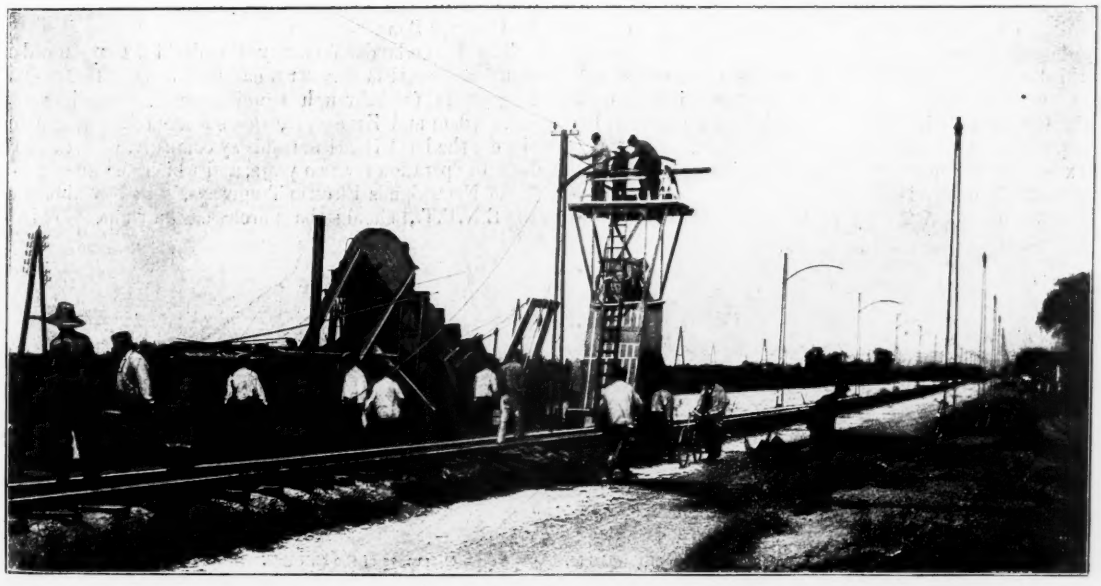
The essential conditions of this concession for the construction of a double track line at the sides of the Government High Road were:—

1. That the concessionaire was required to sheet pile the sides of the road (which is bordered by a canal on one side, and a ditch on the other), in order to secure the necessary width and stability, and to carry out the whole of the works with the least possible interference with the regular use of the road.

2. The period of the concession was for 50 years from December 31st, 1902.

3. All construction plans of every description were required to be submitted for the Government approval.

4. The period allowed for the construction was two years.



Pile-Driving and Dredging by the Side of the Government High Road.

5. The speed allowed for the cars was to be regulated by the Secretary of State, and the speed actually permitted was 35 kilometres per hour. The Secretary of State was also empowered to fix the maximum fares, but it was generally understood that the

maximum fares allowed should be equal to those of the steam railway.

6. At the expiration of the concession the Government was to take over, without compensation, all the property of the company located on Government lands. There were a large number of minor provisions regarding protection of working men as to hours of labour, accident insurance, pensions, and so forth, and minor provisions as to the protection of the various water boards, drainage boards, telegraph companies, railways, &c.

In addition to this concession for the use of the Government High Road, it was necessary to obtain an entrance into Amsterdam, and to do this satisfactorily the concessionaires obtained options on a private right of way for about two miles from the Government Road to the Amsterdam city limits, at a point near the terminus of one of the Amsterdam Corporation Tramway lines. In obtaining this private right of way, the option was made to include a strip of land for the whole distance, wide enough to permit of a row of building lots on each side of the road being laid out and sold. On this section the tramway is built on a purely private right of way in the centre of the road, with a paved driveway on each side, and outside this driveway the usual footpath and building lots are arranged.

This view shows the new tramways, the Government Road, the Canal, and the Holland Steam Railway.

POLE-PLANTING NEAR HALFWEG.

Running powers were then secured over the tramways of Amsterdam, then in process of electrification, for a distance of about one mile from the city limits to the corner of the Spui and the Kalverstraat, the centre of the office and retail business districts of Amsterdam. The gauge of the Amsterdam city lines being standard, and the gauge called for by the new concession being 1 metre, it was necessary to lay a third rail for the greater part of this distance, where the lines were common, to permit through running of cars over the Corporation route, this work being carried out by the Corporation at cost and a percentage. This was made more expensive by the fact that a large swing bridge had to be constructed, to permit the through running of the cars, and this was done principally at the expense of the concessionaires. In addition to paying for this bridge and construction, the concessionaires agreed to pay 40 per cent. of the fares which the town would have charged within the city limits, on the basis of its own rates, and also to repay the actual cost plus 10 per cent. expended by the Corporation for repairs and maintenance of the tracks used by the concessionaires, and, further, to pay for power within the city and taken from the city's trolley wire, at a rate of not less than 0·9d. per car-mile. The period of this contract is the same as that of the concession on the Government Road.

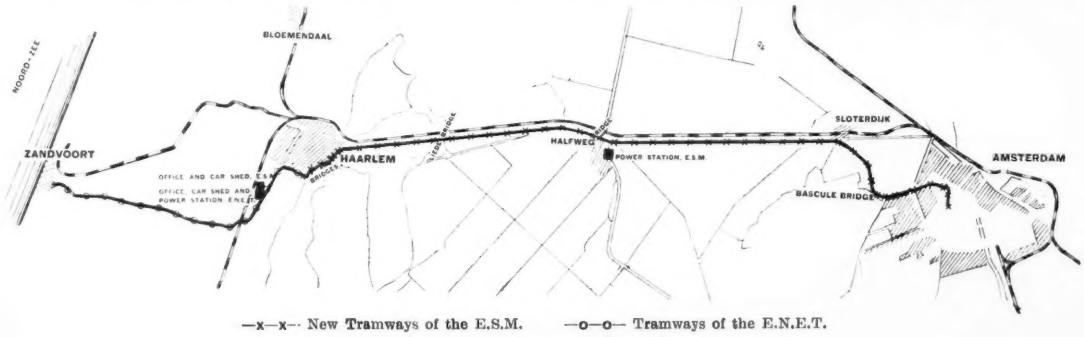
It will be noted that the conditions were most stringent, and that a net profit on the running in the city of Amsterdam could not be looked for; but, on the other hand, the distance within the city was a very short one (1·4 miles in a total run of 12), and to secure the satisfactory terminal facilities, these concessions were necessary.

Messrs. Anderhagen & Neumeyer then executed an agreement with the Corporation of Haarlem, permitting the construction of about 1½ miles of tramway within that city, to give the company a satisfactory terminus at its western end. The Haarlem concession is also for a period of 50 years, and is without unusual features, except that the concessionaires were required to pay large amounts for the renewal of bridges and similar works in the city of Haarlem.

When all the concession arrangements above outlined were completed, local permits obtained, &c., the matter was presented to an American syndicate, headed by Mr. H. J. Pierce, of Buffalo, who, after full investigation, decided to take the matter up and to build and operate the proposed line. The Electric Railway Co., of Amsterdam—a Dutch corporation—was organised to take over the concessions and carry out the work. All the shares of this company were subscribed and fully paid for in cash by the Netherlands Tramway Co., of New Jersey, the American syndicate above mentioned. The debentures, of an amount equal to the amount of shares, viz., 3,000,000 guilders (£250,000), were purchased outright by the well-known Amsterdam banking firm of H. Oyens & Sons.

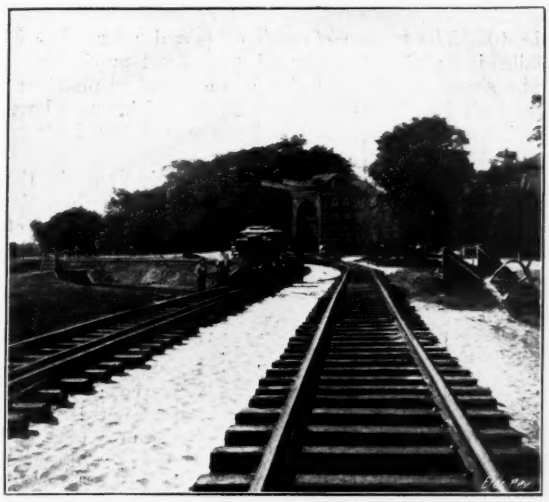
The Netherlands Tramway Co. decided that, in order to secure more satisfactory terminal facilities in Haarlem and to provide for through running arrangements between Amsterdam and Zandvoort, the seaside resort above mentioned, the local Haarlem tramway company, which had then been in operation for two years, and which was known as the First Netherlands Electric Tramways, generally abbreviated to E.N.E.T., should be purchased outright. This was carried out, and practically all of the shares of the E.N.E.T. passed into the hands of the Netherlands Tramway Co., of New Jersey, and for all practical purposes of operation they are consolidated and are to be considered as a single system.

Contracts were then entered into with Messrs. J. G. White and Co., Ld., of London, for the complete design and construction of all the works required, including the permanent way, overhead work, power station, car-shed, shops, office buildings,



—x—x— New Tramways of the E.S.M. —o—o— Tramways of the E.N.E.T.

MAP OF THE TRAMWAY SYSTEM.

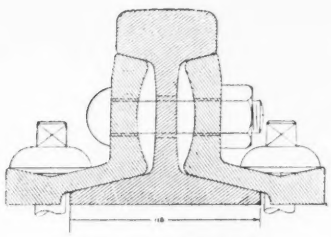


Junction of Private Right-of-Way With Government Road at Sloterdyk.

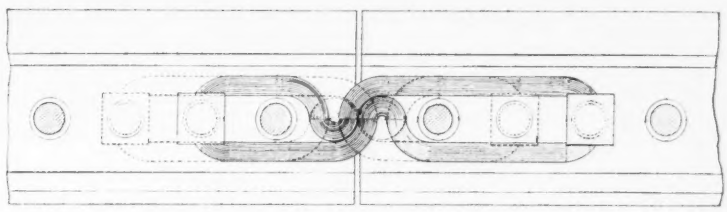
the ground was 1·6 m. below the Amsterdam datum, and the height of the finished road was plus ·70, making a fill of 2·3 m. The total fill was 160,000 m³. The total amount of sand brought on the work to make this fill was 280,000 m.³; there was, therefore, used on the work 120,000 m.³ more than shown on the embankment. This was due to the bad soil, this additional amount sinking into the ground. The sand was brought in scows from a distance of 20 km., and was unloaded by means of elevators into trucks, and hauled by engines on the work. On this section, two steel bridges and one wooden one had to be built.

At the village of Sloterdyk, the line joins what is called the Government High Road, between Amsterdam and Haarlem. On the north side of this road is a canal running the whole length, except through the village of Halfweg; on the south side is a ditch. The ground over this distance is what is known in Holland as "Polder land." The surface is below the canal level, and is divided by ditches, which lead to various points where windmills are placed to pump the water from the low level up into the canals. The land is of a boggy, peaty nature, and is used wholly for grazing purposes.

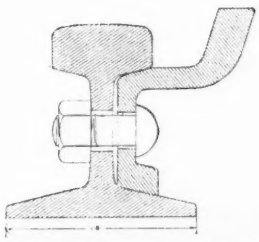
On the north or canal side of the Government Road, the distance from centre to centre of piles is 1·25 m. The



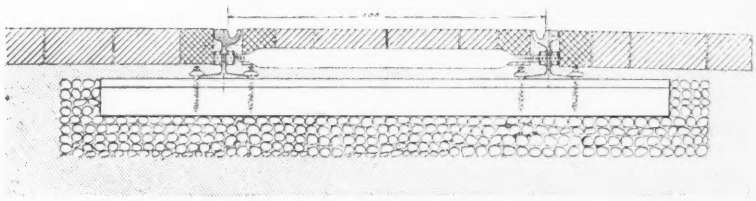
Section of Vignoles Rail.



Mode of Bonding Under Fish-Plates.



Section of Vignoles Rail Fitted with Guard.



Section of Paved Track, with Grooved Rails.

bridges, &c., for the Amsterdam—Haarlem interurban line and the reconstruction and additions required by the E.N.E.T. This reconstruction included the double tracking of the line running to Zandvoort, additions to offices and car-sheds, and increase in capacity of the power station. This contract was entered into January 1st, 1903, and the operation of the completed system was commenced in October, 1904. It was the intention to commence operation in the spring of 1904, but the works were delayed, due to the failure of the Corporation of Amsterdam to complete the bridges, and the delay in getting the approval of the Municipality of Haarlem.

From the terminus at Spui to the point marked "bascule bridge" on the plan, the lines are within the city of Amsterdam.

The bascule bridge was designed and built by the Haarlem Machine Co., and is operated electrically. This type of bridge is not easily adaptable for an overhead construction, and therefore the cars run by momentum across the bridge. There is no difficulty in this, notwithstanding the fact that there is a considerable ascending grade and a sharp curve on the Amsterdam approach. Power for working the bridge is furnished by the city, though there is a cable connection made under the canal, so that the power supplied by the Tramway Co. up to the bridge on the west side can be switched on in case of need. The bridge is 12 m. span, 12 m. wide, with 876 piles to the foundations, and contains 220 tons of steel.

From the bridge in question, to Sloterdyk, the line runs over private right-of-way for 2,444 m. The average surface of

Centre-Pole Construction on Private Right-of-Way.

piles are heavy kolders or hellens, 5 m. long, about 22 cm. in diameter at the top and 16 cm. at the point.

A purlin 13 × 20 cm. of squared pine is carried along the whole length of the piling, to which it is bolted. Behind this purlin a row of planks 6 cm. thick and 2·50 m. long, or longer, are driven in; these planks are 28 to 30 cm. wide, and the joint is of fishmouth construction.

At the back of every other pile two anchor piles are driven in, 3 m. long. Behind these anchor piles, which are at 60 cm. centres, there is an anchor plate of wood, 80 cm. long × 13 × 15 cm. The anchor plates are joined to the sheet piles with 25 mm. round iron rods 3·80 m. long.

On the south side of the Government Road the piles are of roughly dressed firwood, 6 m. long, and 1·10 m. centres. Each of these piles is creosoted.

The back of this piling is shuttered with boards 5 cm. thick, of creosoted pine, at such a depth that the bottom is 10 cm. below the summer level of water in the ditch.

Below the shuttering is a purlin 8 × 18 cm., and behind the purlin is a row of fir planks 6 cm. thick, with fishmouth construction, and at least 3 m. deep. The heads of the piles are covered with a creosoted pine plate, 5 × 28 cm.

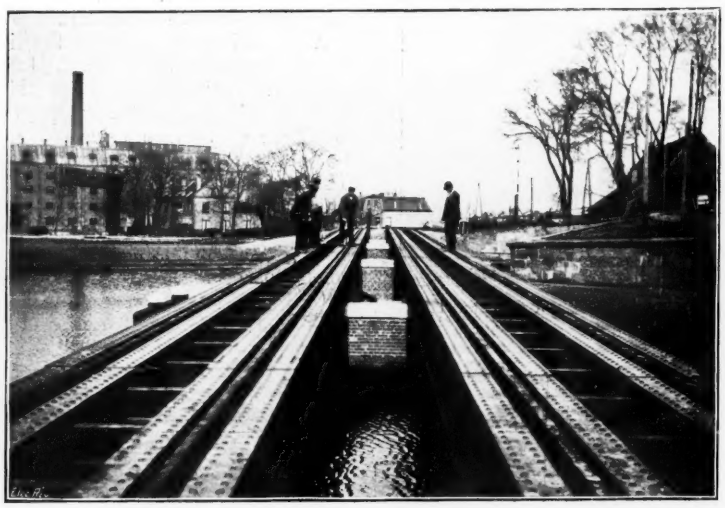
For anchoring every alternate pile, two anchor piles 3·50 m. long, of creosoted pine, are driven in. Behind these piles are anchor plates 13 × 15 cm., 0·80 m. long, connected with the purlin by a round iron rod 4 m. long.

The filling has been carried out behind the sheet piling spoken of above. The filling has been done with pure sand, well rammed down. In this filling, a space is left, 15 cm. deep, and 2 m. wide, under the sleepers; this is filled in up to the bottom of the sleepers with pure coarse gravelly sand.

The adjoining roads and approaches are filled up over their full width. The grades of the approaches are at least 1 in 40. The surface of such roads and approaches is metalled in a similar manner to that employed previously.

The slopes in the canal side above the sheet piling are covered with basalt pitching, 20 to 25 cm. thick, over a layer of broken bricks 12 cm. thick laid on the sand filling, with a slope of 1 in 1.

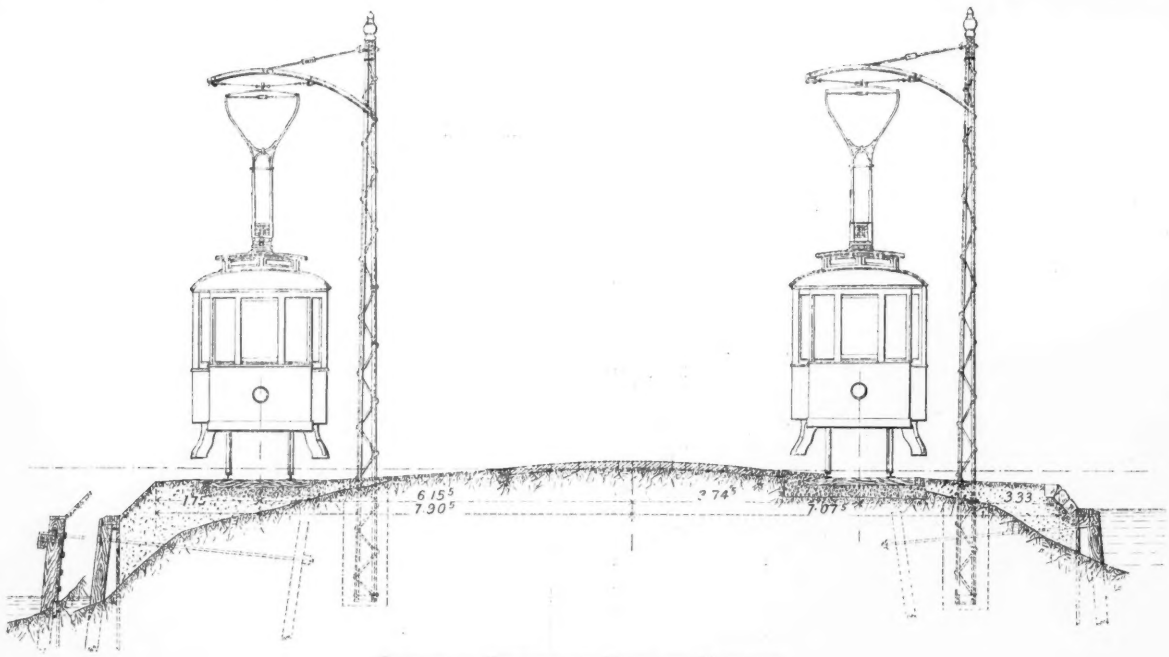
The paving of the High Road was practically relaid the entire length, to the datum level of Amsterdam. The amount of work involved on the Government High Road may be seen from the following figures:— 20,500 uncreosoted and 23,000 creosoted piles; 2,700 m.^{3} uncreosoted and 1,900 m.^{3} creosoted timber; 160 tons of iron for tie-rods; 5,000 tons of basalt; 75,200 m.^{3} sand filling; 31,600 m.^{2} of brick paving; 9,600 m.^{3} of dredging; 1,700 m. of fencing; and 74 gateways and approaches to farms and houses on the south side.



Steel Bridge near Halfweg.

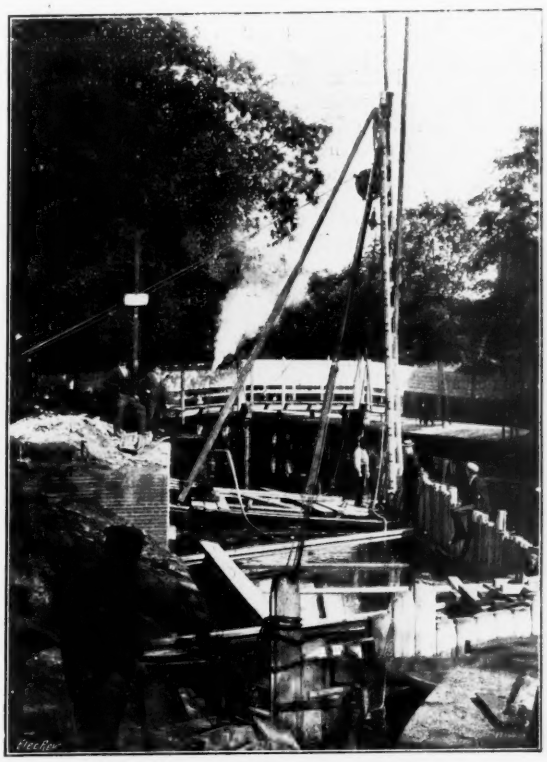
When the work was at its height on the entire line, there were in use 2,360 labourers, 2 steam locomotives, 1 electric locomotive, 31 steam pile drivers, 3 steam spouters, 1 steam crane, 60 hand pile drivers, 1 steam bucket rigger, and 165 flat boats and scows.

The permanent way along the Government High Road and also along the private right-of-way is practically of steam railway construction. The rails are of Vignoles or T section, weighing 70 lb. per yard. The section is the standard of the American Society of Civil Engineers for that weight. The rails rest directly on the sleepers, spaced 76 cm. centre to centre, except at the joints, where they are 50 cm. The joints are staggered. The sleepers are creosoted Norway pine, 25 × 11·5 cm., the upper edges being bevelled, and the rails are fastened by screw bolts. Double concealed bonds are placed at each joint. The length of route along the canal is 13,417 metres.



Section of Government Road and Tramways.

At the village of Halfweg, which, as the name indicates, is situated approximately half-way between Amsterdam and Haarlem, the line crosses two canals. Bridges were built over these specially for the purposes of the tramway. One



Kleine Hout Bridge at Haarlem, in course of Construction.

bridge has four spans, each 15 metres, and the other two spans of the same length.

Through the village of Halfweg, there are two sections of single line. These short sections are controlled by an automatic electric signalling device of the Siemens-Schuckert Co., which are described.

The line enters the city of Haarlem at the old Amsterdam Gate. The terminus in Haarlem coincides with the terminus of the Zandvoort line belonging to the E.N.E.T. system. The construction in Haarlem is all of grooved girder rail. The rails weigh 84 lb. to the yd., and rest directly on the sleepers.

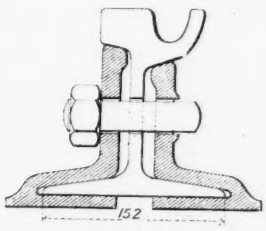
In Haarlem it was necessary to reconstruct a swing bridge, to entirely rebuild three other bridges, and to construct a new one for the tramway only at the Amsterdam Gate.

The power station is situated in a central position at Halfweg, midway between Amsterdam and Haarlem, and practically in the best position for distributing power to the line, being located on the banks of the Ringvaart Canal, which will afford cheap carriage for coal and other supplies, and also abundance of water.

Owing to the nature of the country and the poor condition of the ground, an elaborate arrangement of piling was necessary, the entire site being piled with 46 ft. long × 9¾ in. diameter piles, placed 4 ft. 1 in. apart, each pile being estimated to carry 4 tons. On top of the piles, runners 7⅞ in. × 9¾ in. are carried the entire length of the building, and support a floor 3 in. thick over the space occupied by the building.

The buildings are of brick, substantially and neatly finished with stone trimmings. The area occupied by the power station site is about 9,150 sq. ft., with sufficient space for future extensions. A wharf has been built 26 ft. 3 in. wide, and immediately adjoining is the boiler house, which is 88 ft. 7 in. × 52 ft. 6 in. The engine room is 59 ft. × 34 ft. 7½ in. × 21 ft. 4 in. high from engine room floor to top of wall. Situated at the end of the boiler room is a coal store-room, with a capacity of 400 tons.

The main engine plant consists of three Belliss self-



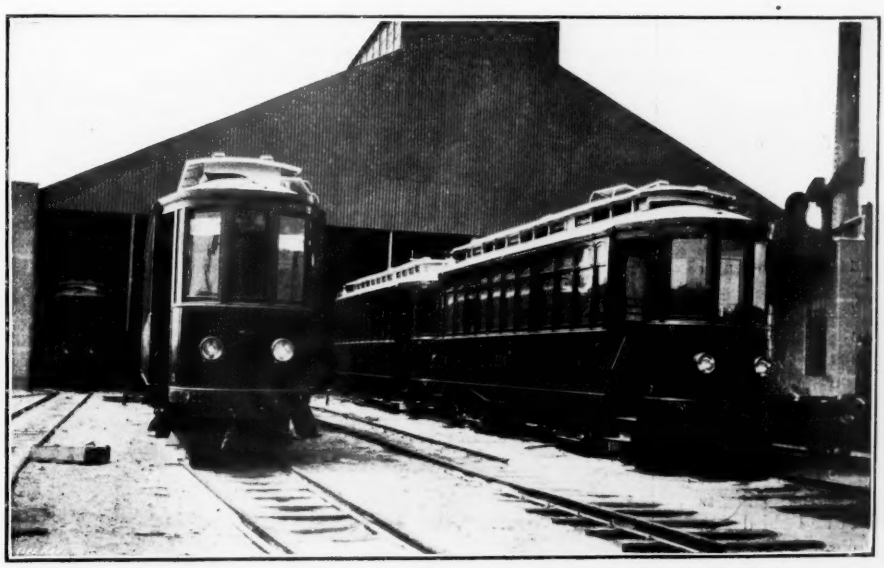
Section of Grooved Rail and Fish-plates.

lubricating, three-crank enclosed triple-expansion engines, each of 430 B.H.P. at economical cut-off, and having a steam consumption of 13½ lb. per B.H.P.-hour with superheated, and 17 with saturated, steam, with 26-in. vacuum. The speed is 375 r.p.m.

The boiler house contains six Lancashire steel boilers, by Messrs. Stork, of Hengelo, Holland, the heating surface of each boiler being 926 sq. ft., grate area 35 sq. ft., steam pressure 160 lb. per sq. in. The boiler shell is 7 ft. 6 in. diameter × 27 ft. 10 in. long, Each flue has five Galloway tubes.

There are six Stork superheaters, which are placed in the flues directly behind the boilers, and arranged to work at a temperature of 500° F. By means of flue doors, the superheaters can be cut out, and the engines worked by saturated steam. Each superheater has a heating surface of 330 sq. ft.

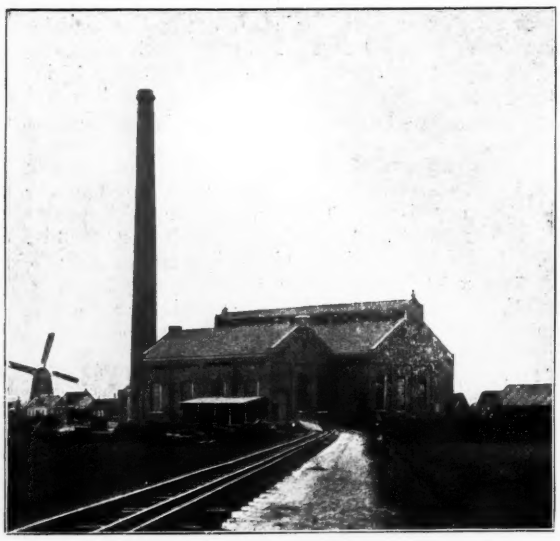
The generators, made by the Société Anonyme Westinghouse, Le Havre, are three in number, coupled to the engine



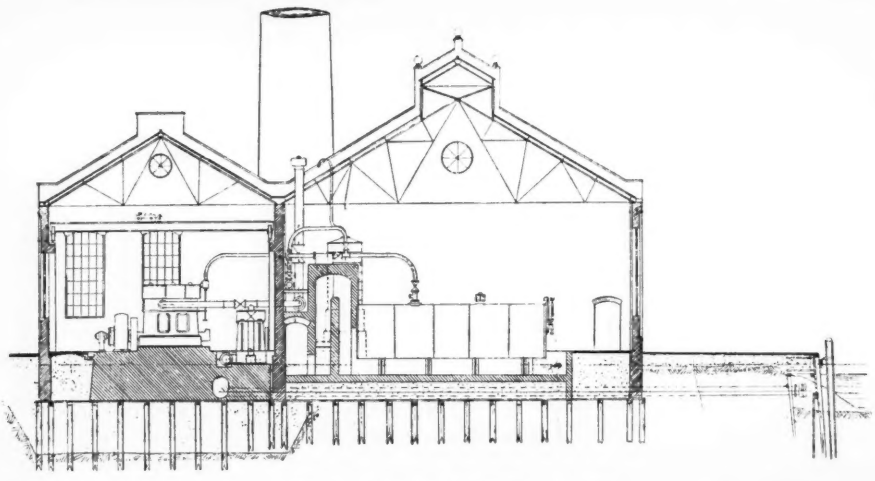
View of Cars and Car-shed.

shafts. The output of each compound six-pole machine is 300 KW., at 525 to 575 volts., 375 r.p.m.

The switchboard, also by the Société Anonyme Westinghouse, consists of five panels (three generating, two feeder



EXTERIOR OF POWER STATION OF THE E.S.M.



VERTICAL SECTION OF POWER STATION.

constructed by Messrs. Louis Smoulders & Co., spans the engine room.

The chimney is of brick, 131 ft. high × 5 ft. 5 in. diameter inside, and is lined with firebrick to a height of 65 ft. The foundations consist of a bed of concrete 23 ft. square × 6 ft. deep, supported by wooden piles 9¾ in. diameter × 46 ft. long, placed 2 ft. 2 in. apart.

The condensing plant for the main engines, made by the Nederlandsche Fabrick, Amsterdam, consists of three jet condensers, each capable of condensing 9,000 lb. of steam per hour, with Edwards air pumps.

The feed water to the boilers is taken from the adjoining canal, which contains a certain amount of suspended matter necessitating the filtering of the water. Under the boiler room floor, in front of the boilers, a duplicate arrangement of tanks is situated, built of brick, for this purpose.

A vertical exhaust steam feed-water tube heater, made by the Wheeler Condenser and Engineering Co., is placed directly behind the feed pumps. Two sets of direct driven duplex feed pumps, made by the Buffalo Pump Co., New York, are installed, each capable of delivering 2,400 gallons per hour against 300 lb. per sq. in.

All the steam piping was made by Seiffert & Co., of Berlin. From the angle stop valve on boilers 6 in. pipes join the cast-steel header of the superheater, and then branch into the 8 in. main header, from which the engines take their supply of steam. Very ample provision is made for draining the steam pipes and valves.

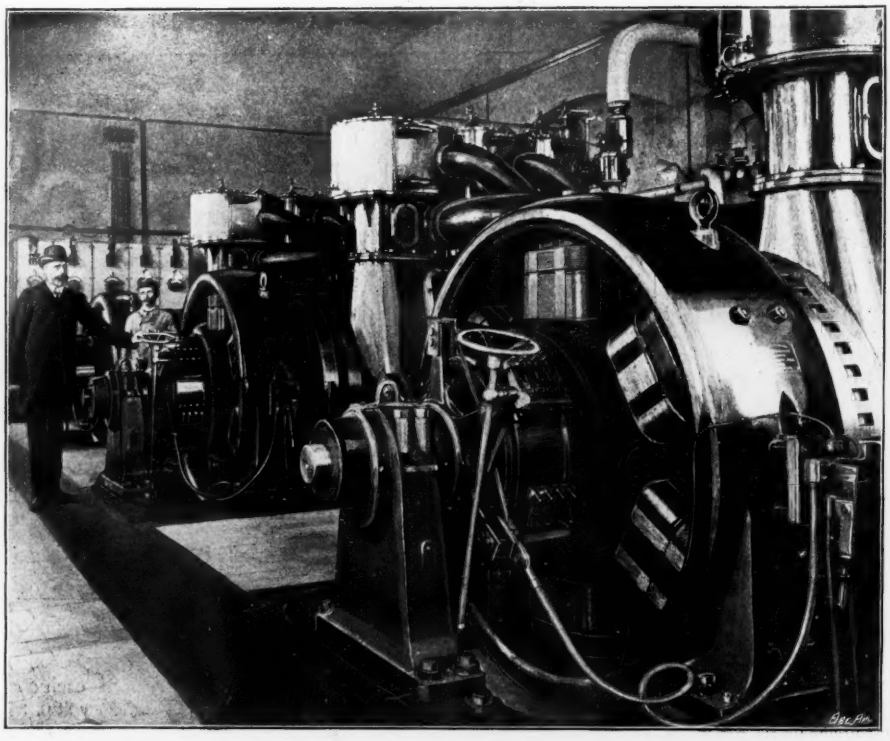
From each of the three engines, an exhaust pipe is carried across the engine room at a height of 6 ft. 6 in. into the boiler room, where the three pipes connect up through an automatic relief valve, to a vertical pipe leading to the atmosphere. A branch pipe is taken from each exhaust pipe into an independent jet condenser.

panels) of marble, fitted to a steel frame, and equipped with the usual standard instruments, switches, &c.

The boiler foundations rise from the wooden floor, and are composed of brick arches filled in with sand.

The foundations for the main engine and condensers are built of concrete, the engine centres being 14 ft. 9 in. apart. Surrounding the engine and condenser foundations are arches of concrete, which support the engine room floor. The flooring consists of tiles bedded in concrete, and supported on two layers of brick, the tiles and brickwork being laid in a bed of sand.

A 10-ton overhead hand travelling crane,

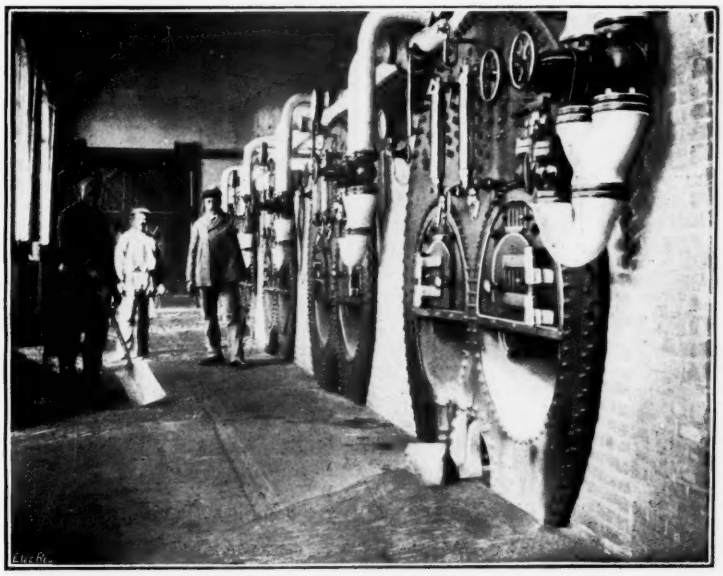


VIEW OF GENERATING PLANT.

The new car-shed was constructed alongside the existing power station of the E.N.E.T. The track construction in the car-shed was carried out entirely with cast-iron columns, which carry the rail directly. These columns have flanged bases, resting on the pile foundations. The length of the columns is 2·20 m., and the depth of the pit in the clear is 1·40 m. The distance from centre to centre of the columns is 2 m., and the rail bridges this distance without any additional support. This construction gives the minimum of obstruction in the pits.

The 34 cars were made by La Métallurgique, at Nivelles, Belgium. They are divided into two compartments, the larger for seating 22 passengers, and the other seating 12 (for smokers). The cars are vestibuled. Besides hand brakes, the cars are equipped with Christensen air-brakes, supplied by Messrs. R. W. Blackwell & Co., Ltd., London. The air-pumps are worked by an electric motor automatically regulated. The trucks were also furnished by La Métallurgique. The special feature of these trucks is that the swing hangers are pivoted on the outside of the truck frame. This permits a maximum distance between the supports of the spring plank and a maximum distance centre to centre of the swing hangers. The result of this construction has been most satisfactory. The trucks are very easy running, even at the higher speeds of 35 to 40 miles per hour.

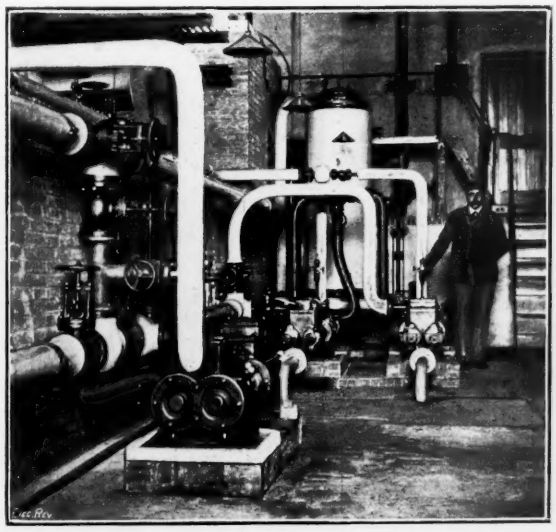
The motors are of 50 H.P. each, and were furnished by the Union Elektricitäts Gesellschaft, now incorporated with the Allgemeine Elektricitäts Gesellschaft.



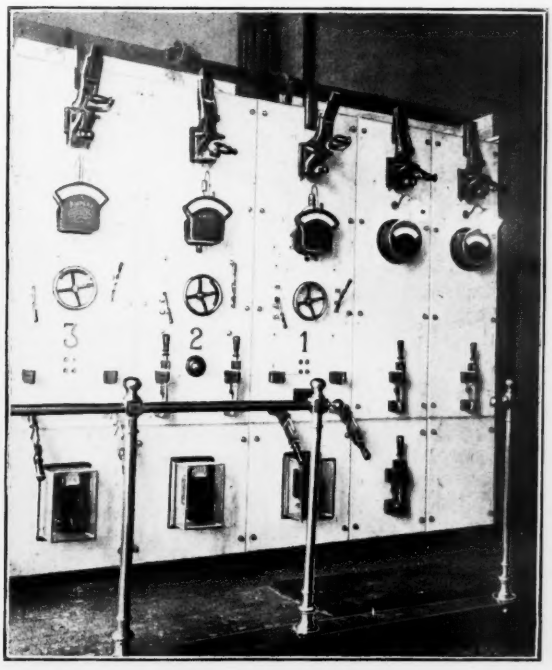
Front View of Boilers.

The overhead equipment is on the bow system, with a pressure of 500 to 575 volts. The poles are of the lattice girder type, of three different weights, viz. :—A, 250 kg. ; B, 317 kg. ; and C, 590 kg. A and B are constructed of two channel sections bolted together, and C of angles. The poles are provided with heel-plates, and are set 2 metres in concrete. The bracket arms consist of two channel sections bolted together. Bracket-arm construction is used throughout, except in Haarlem, and the poles carry both the feeder cables and the telephone wires. The feeder cables consist of two bare copper conductors, each 194 sq. mm. in cross-section. The trolley wire is 68 sq. mm. in cross-section. On that part of the route from Haarlem to Zandvoort, bow contact is made with two wires simultaneously. The trolley wire is zigzagged, in order to equalise the wear on the bow. The height of the wire from the ground varies in Amsterdam, on the Government Road, and on the E.N.E.T. section; this variation in height at first caused considerable trouble with the bows, but at present the bow base is so arranged as to keep an equal tension on the bow at the respective heights. The wire is held up by mechanical clips, which, with the bow, give noiseless running.

The safety signalling apparatus previously mentioned, operates in such a manner as to prevent two cars entering at the same time upon a section on which traffic passes in both directions, and the end points of which cannot be seen from one another. The accompanying drawing (p. 24) shows the wiring of the apparatus and the connections of the same with the contact pieces, *a*, *b*, *c*, *d*, and the lamp signals, overhead wiring, and connections to earth. The diagram is given only for the track A—B, since the connections would be the same for A—B as for C—D.



Feed Pumps and Heater.



Main Switchboard.

At each switch point where cars enter and leave, the same contact pieces *a*, *b*, *c*, *d*, are installed, which on the passing of a car are connected by means of a stirrup with the trolley

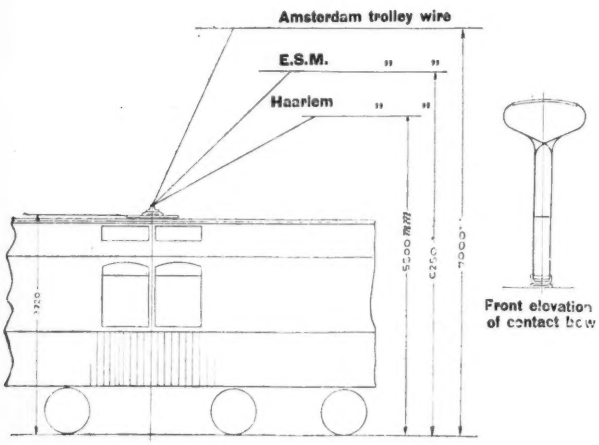


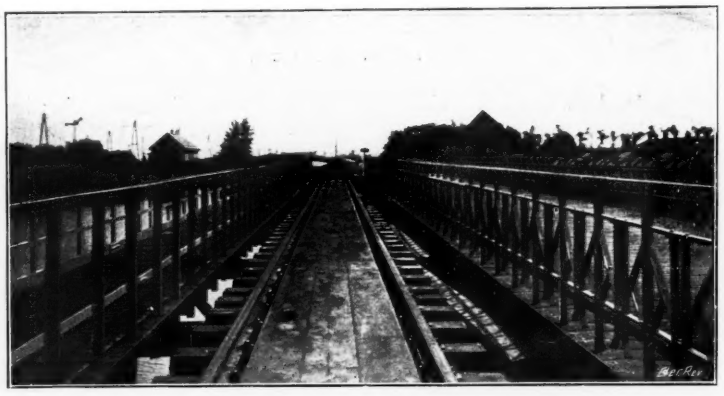
Diagram showing Varying Heights of Trolley Wires.

wire; in consequence thereof, a current flows for a brief period. This current passes through the windings of an electro-magnet, *e*, whereby the armature of the magnet is drawn up, and a ratchet *f* is engaged with a toothed wheel *g*, thus causing this toothed wheel to rotate through a space corresponding to one tooth. Firmly connected to this toothed wheel is a contact wheel, *h*, with one segment, *i*. This segment forms, with the spring, *k*, an arrangement for breaking contact in the circuit of the light signals in such a manner that the circuit is usually open; therefore, no light burns when the section is free—that is to say, when no car is passing between A and B. As soon, however, as a car enters the section in one or other direction, a turning movement acts on the toothed wheel, as above described, and the lamps are lit; when the green lamp is alight, the signal is at free, and when the red lamp burns, the signal is at danger. When, now, the car leaves the single track section, and touches the contact apparatus in connection with the trolley wire, the toothed wheel is turned in the opposite direction, by means of which the spring, *k*, slips off from the segment and the lamps are extinguished.

It is easy to see that the apparatus works in exactly the same manner for several cars following one after the other, and that the number of cars is only limited by the number of teeth on the toothed wheel. By the entrance of each car into the section, the wheel is turned forward one tooth, and by the same car leaving the section, it is turned back by one tooth, so that the lamps are extinguished only after all the cars have passed out of the section.

If we now follow the course of a car from A to B, we notice that the car on nearing the point A, touches the contact piece, *b*, and through a stirrup operates the relay as above described. The spring, *k*, touches the segment, and the green lamp lights up, and is seen from the car, showing that the track is open. At the point B the red danger signal appears; the section, therefore, is closed for cars coming from the direction of B. After the car has passed the stopping place ("Halt"), it passes through the single track section, and making contact with *d* works the relay in the opposite direction, and the lamps are extinguished. The same process is gone through when cars pass from B to A, with this difference, that the relay at B lights or extinguishes the lamps.

When it happens that two cars make contact at *b* and *c* simultaneously, red and green lights appear at both ends. In order to prevent any confusion in the mind of the drivers, and in order to give one car the right of way, the signals are spaced as marked on the wiring diagram, the stopping place being located at A between the signals, and at B in front of the signals. By this means, when accidental simultaneous contact is made at *b* and *c*, the car coming from B will see only the green light, which means "free track." The car coming from A, however, will see from its stopping place only the red light danger signal, and will, therefore, be obliged to wait until the first car has passed through the section. If the signal lamps do not light up, it is assumed that the apparatus is out of order, and precautions are taken accordingly. The apparatus and signal lights are attached to poles near the switch points. The contact pieces through which the relays are operated are spaced a short distance from the signal lights on the span wire. The signal wires, which are made of silicon bronze of 2 mm. diameter, are fixed to the poles by means of cross-pieces of angle iron. The insulators are made of hard porcelain.



View on the Liede Bridge.

As regards the complete system of tramways, it will be noticed that its construction is unique, owing to the character of the country through which it passes. No other instance exists in which sheet piling has been required on both sides of the track for a distance of 10 miles, almost in a straight line from end to end. The system is rather a light railway than a tramway, most of the routes being on

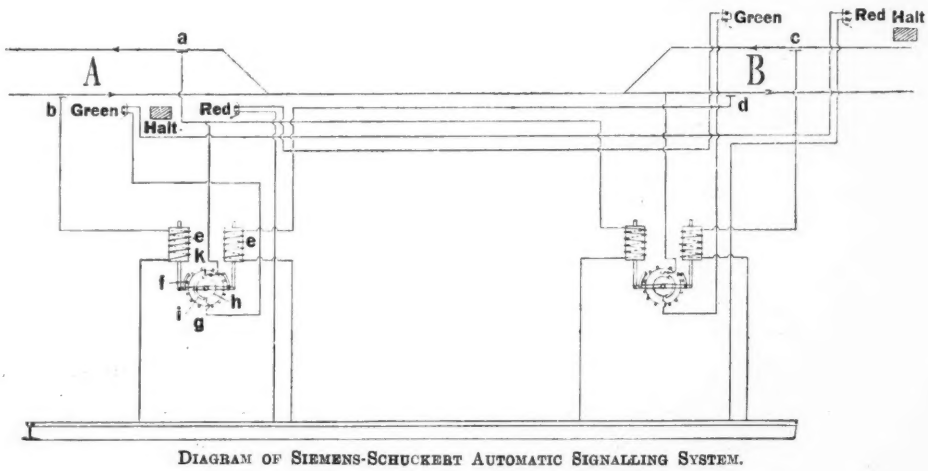


Diagram of Siemens-Schuckert Automatic Signalling System.

private right-of-the-way, and fairly high speeds being attained. The simple mode of crossing the bascule bridge by coasting deserves notice.

It will be observed that municipal authorities in Holland are no less grasping than in this country; but this is not always the case on the Continent, where many of the municipal authorities cordially co-operate in the construction of works from which the public will derive benefit.

The engineer for the whole of the work above described was Mr. A. N. Connett, whose unique experience in the construction of tramways of all kinds enabled him to successfully cope with the exceptional difficulties met with in this instance. Mr. Connett's chief assistant, in charge of the work, was Mr. C. E. Wood, who was formerly engaged on the construction of conduit tramways in America, and at Bournemouth and London. The engineer and manager of the two companies, locally known as the Electrische Spoorweg Maatschappy and the Eerste Nederlandsche Electrische Tramways, is Mr. C. H. Julius.

In conclusion, we wish to express our indebtedness to Messrs. J. G. White & Co. for the particulars and illustrations embodied in this article.

LIGHTING AND POWER NOTES.

(*Continued from page* 16.)

Tonyrefail.—The electric light undertaking at Tonyrefail was formally inaugurated on December 27th by Mr. Godfrey Clark, J.P., Talygarn, chairman of the Llantrisant D.C.

Torquay. — On 4th inst. a L.G.B. inquiry was to be held into the application of the T.C. for sanction to borrow £42,000 for the erection and equipment of a new electrical power station in Upton Valley.

Twickenham and Teddington.—The Electric Supply Co. has reduced the flat rate from 6d. to 5½d. per unit, with free renewal of lamps. The maximum demand rates continue to be 7d. and 3d.

TRAMWAY AND RAILWAY NOTES.

Bath.—The electric tramways on Saturday last completed their first year's running. The system was incomplete until August, and the most profitable season of the year was over before the full complement of cars was running. The receipts, however, averaged £634 weekly, and totalled £33,000. The population served is about 68,000. The working expenses have been about 55 per cent., and it is expected that the profits will allow of the payment of debenture interest and accumulated preference dividend for two years.

Belfast.—On New Year's Eve the tramways were formally handed over by the company to the Corporation, the function being performed by Mr. J. Barbour Glen, secretary of the company. Mr. Glen drove the first car in 1872, and he drove the last one, on the last night of 1904. The event was celebrated in the Central Hall by a luncheon, at which the Lord Mayor, Sir Oller Jaffe, and the Corporation, were present. The Corporation took over the existing staff.

Bournemouth and Poole.—The award in the Bournemouth Tramways arbitration case was received on Friday afternoon, last week. The sum of £112,000 has been fixed as the amount to be paid by the Bournemouth Corporation to the Poole and District Electric Traction Co. for their tramway undertaking, the Corporation to pay the costs of the proceedings. The claim of the company amounted to £427,000, while the valuations on behalf of the Corporation varied from £55,000 to £67,000. The award, which is signed by Mr. Justice Lawrence, who, as Mr. A. T. Lawrence, K.C., sat as umpire at the arbitration, which lasted 10 days in London, recites first the various Acts of Parliament, and after references to other matters connected with the case, concludes as follows:—"That the Corporation do pay to the company as consideration for the said sale and purchase, and in full satisfaction of all the several sums above-mentioned, the sum of £112,000. And I further award and adjudge that the Corporation do pay to the company the costs of, and incidental to, the reference and the costs of this award. And I direct that if the company shall in the first instance pay the costs of this award, that the Corporation shall repay to the company the sum so paid." General satisfaction is felt by the ratepayers at the amount of the award, for it was quite expected that it would be a larger sum. Alderman G. J. Lawson, the Deputy Mayor and chairman of the Tramways Committee, in an interview with our local representative, expressed the opinion that the strongest point made for the Corporation, was the "fair market value" clause in the agreement. The insertion of that clause proved the saving clause for the Corporation. Over and over again the arbitrator for the Corporation returned to that clause, when the witnesses on the other side were giving figures supporting the claim of over £400,000. The Mayor estimates that the total cost to the Corporation will amount to £120,000, and the Deputy Mayor agrees with that estimate, which is based on a daily cost of arbitration proceedings at £500 per day for 10 days, cost of shorthand notes, &c. A special meeting of the Tramways Committee will be held next week, and the two tramway systems will, it is expected, be connected with as little delay at possible. This connection will provide a through service from Poole to Pokesdown, a distance of over seven miles through the main roads of the two boroughs. It also means the running of a Sunday service of cars from Poole to Bournemouth, the Corporation being under agreement to carry this out, and it remains to be seen if it will also continue the service through Bournemouth.

Brussels.—The new electric tramway in Brussels, between the Bourse and Jette Sainte Pierre, was opened for traffic last week. Work is well in hand on the application of electric traction on the Bourse—Place Stephanie and Berchem Ste. Agathe routes.

Bury.—Opposition is being offered by a section of the ratepayers to the Corporation Tramway Bill, by which powers are to be sought to extend the existing lines to the boundaries of the borough, in various directions, and also to Ramsbottom and Edenfield, returning by way of Shuttleworth and Walmersley. The total length of the proposed extensions is over 20 miles, and the estimated cost £194,000. At a recent meeting, it was resolved that the powers sought should be postponed until the working of the existing system has been satisfactorily tested.

Dartford.—The U.D.C. has applied to the B. of T. for an extension of time in which to carry out the Tramways Order, which expires by effluxion of time in February.

Glasgow.—Pollokshaws T.C. has decided to oppose the Glasgow Corporation Tramways Consolidation Order, which provides for the lowering of Coustonholm Road to allow double-deck cars to pass underneath the bridge of the Cathcart District Railway. The meeting also agreed to oppose the Glasgow Corporation General Order, in respect that by Clause 78 it is proposed to restrict the assessment within burghs, on the underground and overhead cables and wires of the Glasgow Corporation to 25 per cent. of their value. The Council agreed to approach the other burghs interested with the view to joint action being taken on the subject.

Lancaster.—Since the alteration in stages and improvement in the service, there has been a substantial increase in the traffic returns. It was reported at the Town Council meeting on December 28th, that 25,600 more passengers had been carried, and the receipts had increased by £77 10s. during the past month. The question of running motor-buses to parts of the town not served with trams is under consideration.

Leeds.—The extension of the tramways from Kirkstall to Horsforth, a distance of a little over two miles, has just been commenced. In open competition, the Leeds Steel Works secured the contract for the supply of 850 tons of steel rails, at £5 7s. 6d. a ton. The whole undertaking, which is expected to be finished early in the summer, will, it is estimated, cost about £25,000.

Littleborough.—The U.D.C. has received from the Board of Trade, sanction to raise loans of £7,500 for the purchase of the tramway undertaking, and £27,354 for its reconstruction and electrical equipment.

Liverpool.—The City Council has now before it the draft of an Omnibus Bill, by which, among other things, power will be sought to construct important additions to the existing routes of electric tramways in Liverpool, in order to establish goods traffic between the Liverpool docks and the lines of the South Lancashire Tramways Co. According to existing plans, a connection may be made between the docks at each end of the city—the north-end and the south-end—and the main existing lines of tramways. The idea of utilising the Liverpool tramways in the night time for the conveyance of goods, as suggested a year ago, is now viewed as impracticable, having regard to the cost of working a special night service. One new project of the City Council, for which powers are being sought, contemplates the construction of entirely separate lines of tramways from those now used for passenger traffic, for goods traffic.

Liverpool and Southport Electric Railway.—An exciting incident took place on the Liverpool and Southport Electric Railway about 6.30 on Thursday evening, December 29th. An electric passenger train, through some mischance, ran through the gates of a level crossing.

Long Island City, N.Y.—Some 80,000 H.P. of Babcock and Wilcox boilers are being put into the new power station intended to generate energy for the electrification of the Long Island Railroad, which system will be ultimately connected with continental lines by means of a tunnel under the East and Hudson rivers, and beneath Manhattan Island.

A tunnel for electric street cars is also under construction between Long Island City and Manhattan, Mr. August Belmont having acquired the franchise of a tunnel originally sanctioned 10 years ago.

Manchester.—The car repairing works built by the Corporation, in Hyde Road, are now approaching completion. At this establishment it is intended to do the whole of the work connected with the maintenance of the City cars in a state of efficiency, and also to build any new cars that may hereafter be required. The whole of the existing equipment has been furnished by outside contractors. The new works are of the most approved type. On one side of the main avenue are the machine, cabinet-makers', and paint shops, and also shops for the construction and fitting together of the woodwork of the cars. On the other side are smithy, brass foundry and fitting shops, repairing and electrical shops. Under the authority of the Act of Parliament obtained last session, the new parcel carrying department in connection with the Manchester tramway system, is being organised. It is hoped to bring the system into operation about the beginning of March. The Manchester Tramways Committee now employs a staff of about 3,000 men. Its estimated gross income for the current year (to the end of March next) is £640,000.

Metropolitan Railway.—The new electrical service was inaugurated on January 1st. The first of the new trains left the depôt at Neasden at 8 a.m. for Baker Street, and during the day a service of 20 electric trains was run between Baker Street and Willesden. In addition a number of trains ran as far as Harrow and Uxbridge. The company hope to have their section of the Inner Circle ready in about a month, but the working will be delayed until the completion of the District Co.'s section.

Poole.—The T.C. has received a communication from Messrs. Batten, Proffitt & Scott, stating that it was intended to promote a light railway between Bournemouth and Swanage, which would cross the entrance to the harbour by means of a conveyor suspension bridge. The Railway Committee decided not to support the scheme. A memorial was received, urging the necessity of an extension of tramways, and suggesting that the local authority should promote a line from the County Gates to the Haven Hotel, passing through Branksome Park, Canford Cliffs, and the Sandbanks, and also a line from Parkstone along the Sandbanks Road to Sandbanks. It was resolved that the town clerk be instructed to acknowledge receipt of the memorial, and to state that the Council sympathised with the object which the memorial was intended to promote, but was not in a position to consider the matter at present. The Council decided to defer the matter until the Poole and district light railway has been conveyed in pursuance of the statutory authority for that purpose.

Tipton.—At a meeting of the U.D.C. last week, it was reported by the Tramway Committee that an interview had taken place with Mr. Garcke and Mr. Lycett, representatives of the Tramway Co., as to the stoppage of the Bloomfield tramways. Messrs. Garcke and Lycett stated that their difficulties with Dudley and Wednesbury would shortly be settled, and then the work of electrifying the line would be proceeded with. The Committee, it was also stated, had written to the Board of Trade requesting them not to grant any further extension of time for the use of steam power on the line from Dudley to Wednesbury through Princes End, and that a reply had been received stating that the Tramway Co. had no intention of again working the line in question by steam traction.

Tyneside Electric Railway.—An alarming accident occurred on the electrified portion of the North-Eastern Railway between Newcastle-on-Tyne and Tynemouth on the 28th ult. It appears that a workmen's train, proceeding along the river-side branch towards Point Pleasant Station, collided with a cart and horse which were on a level crossing. The horse was hurled a considerable distance, and broke a number of signal wires, which, falling upon the conductor rail, resulted in short-circuiting, and set fire to the woodwork of the station platform and two of the coaches. Fortunately, the flames were quickly extinguished, traffic being finally resumed some two hours later.

TELEGRAPH AND TELEPHONE NOTES.

German-Atlantic Telegraph Absorption.—It is proposed to liquidate the Deutsche See-Telegraphen Gesellschaft, of Cologne, as a result of the acquisition of its system by the German Atlantic Telegraph Co. The former company, which has a share capital of £178,000, was formed in 1896 for the purpose of establishing telegraphic communication between Germany and Spain, and to take over a concession obtained by Messrs. Felten and Guilleaume for other telegraphic connections. As a result of the working of the Emden-Vigo cable, the company was enabled to pay dividends from 1897 to 1901 amounting to 3 per cent., 4⅞ per cent., 6 per cent., 5 per cent., and 3 per cent. respectively. In 1902 there was no distribution, but in 1903 a dividend at the rate of 3 per cent. was paid. The cable undertaking now passes into the possession of the German-Atlantic Telegraph Co., which has made a fresh issue of shares for the purpose.

Hull Telephones.—At a meeting of the Corporation Telephone Committee last week, the engineer was ordered to prepare specifications for increasing the number of lines in the city from 2,000 to 3,000. It was announced that direct intercommunication had been established with the National Telephone Co.'s system at Hessle.

The Paris Telephone Service.—During 1904 the dissatisfaction of the Parisian public with regard to the very inefficient telephone service furnished by the French Administration of Posts and Telegraphs took definite form in the organisation of an Association of Telephone Subscribers, constituted for the purpose of bringing sufficient pressure to bear on the Administration to force it to adopt a reasonable attitude. The French Telegraph Administration acquired the telephone system of Paris in 1889, and since that date the service has gone steadily from bad to worse, until it has now reached such a pitch of inefficiency as to become almost unendurable to the users. Not only is the service very bad, but the general practice of the Administration with regard to rules and regulations, rates and other matters of business relations with the public, is most arbitrary. The Association of Telephone Subscribers has set itself the task of remedying all these evils, or at least of exposing them sufficiently to force those in power to apply the proper remedies. The Association has a steadily growing membership, which already numbers between 4,000 and 5,000 of the Paris telephone subscribers. Since July last a monthly bulletin has been published by the Association, containing articles and reports on the various aspects of the telephone question in France. With a view to acquiring thorough information on the technical side of the telephone service, the Council of the Association has recently retained Mr. Herbert Laws Webb as consulting engineer, and he has furnished a report on the general conditions of a modern telephone system, with a further report on the principal causes of the defective service in Paris. The President of the Association has made formal application to the Administration for Mr. Webb to be allowed to make an official inspection of the Paris telephone exchanges, with a view to reporting on their condition and on the apparatus and methods employed.

Queensland Telephones.—The *Sydney Daily Telegraph* says that the Chief Secretary has received from the Commonwealth a claim for £6,000, for the use of telephones by the Queensland departments since the establishment of the Commonwealth.

Telegraph Development in Nigeria.—It is stated that an important extension of telegraphs is about to be made in Southern Nigeria. The work will occupy about a year, and involves the laying of 400 miles of wire. Starting from the Calabar-Bonny system, the line will strike inland to Onitsha on the Niger, and will continue west across that river to Benin. From that point it will turn south to Warri and be taken across to Lagos. At present there are no lines in the interior of Southern Nigeria, but when the work now about to be taken in hand is completed, a great portion of the known part of the Protectorate will be tapped. At Lagos the new line will join the interior telegraph, which at present extends to Kano, and is being pushed on to Sokoto.

Telegraph Poles.—Mr. Havelik, engineer to the Austrian Telegraph Administration, has published recently in the *Oesterreichische Wochenschrift für den Öffenlichen Baudienst* the results of his observations for many years on the duration of telegraph posts, which he thinks is chiefly ruled by the quality and suitability of the wood, its preparation and erection.—*Zeitschrift für Post und Telegraphie.*

Telegraphic Communication in Canada.—The Canadian people own more than 6,000 miles of land telegraphs and sea cables built and operated with their own money. Sir William Mulock, the Postmaster-General, is understood to have been investigating the conditions under which the properties of the companies now doing business in Canada can be acquired and carried on by the Government in the interests of the people of Canada. The importance of the Government system of telegraph lines of Canada may be judged from the fact that the aggregate mileage is now, roughly speaking, one-fifth of the entire mileage of the private telegraph corporations doing business in Canada. The policy of the Government is not to compete with the existing companies, but to assist them and the country by opening up telegraphic communications with regions where it would not pay the companies to construct and maintain lines and offices.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	Dec. 18, 1904	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Paramaribo-Cayenne	July 13, 1904	
Sitka-Valdez	Nov. 11, 1904	
Cape Haiti-Puerto Plata	Dec. 25, 1904	
Bathurst-Sierra Leone	Dec. 27, 1904	
Assab-Perim	Dec. 26, 1904	
St. Vincent-S. Thiago	Dec. 27, 1904	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	
Rome-Pera	Jan. 3, 1905	

Wireless Telegraphy.—According to the daily Press, the Postmaster-General has made provisional arrangements with the Marconi Co. for the acceptance and prepayment at telegraph offices in the United Kingdom of telegrams for transmission from wireless stations on the coast to ships at sea as from 1st inst. Charges are 6½d. per word, minimum 6s. 6d. for a telegram.

The Marconi Co., in a circular, says the arrangement "represents what may be described as a working partnership" between it

and the Post Office "for the linking of the postal telegraph "to the Marconi system for exchange of traffic."

Messages, which will be despatched at senders' risk, will be received for distances up to 150 miles.

The *Daily News* appears to be elated over what it describes as "the surrender of the British Post Office to Mr. Marconi," and says it "is the greatest triumph of wireless telegraphy recorded up to the present!"

"The solitude of the ocean is gone;" and it also remarks, "True, that slow-moving institution (the Post Office) has not gone very far as yet—it has only undertaken to receive and transmit messages to certain ships within 200 miles of a land station."

The ships with which service begins are the *Lucania, La Touraine, Zeeland, Blucher, Kronprinz Wilhelm, Saxonia, Parisian, Umbria, New York, Finland, La Gascogne, Ryndam, Campania, St. Louis, Vaderland, Rotterdam, La Savoie, Moltke, Ivernia, Minnetonka, Etruria, Philadelphia, Kroonland, Kaiser Wilhelm der Grosse* and the *St. Paul.*

It is announced that the Turkish Government has entered into a contract with the Siemens & Halske Co., as representing the Berlin company for wireless telegraphy at Constantinople, for the establishment of two stations for wireless telegraphy, at the expense of Turkey, over a distance of 434 miles. The two stations are to be located at Rhodos, the capital of Rhodos Island, and at the port of Derna, in the vilayet of Tripolis, Africa. The installation, which will be arranged on the system united under the Slaby-Arco and Braun-Siemens patents, is to be set in operation at the beginning of next May, and two electricians will be sent to Turkey at the request of the Sultan in order to supervise the working. If the results are favourable, it is stated that the Sultan will have other installations established by the company on the Red Sea coast.

It will be remembered, as mentioned a month or two ago, that the Marconi Wireless Telegraph Co. has sought to obtain a monopoly of wireless telegraphy in the Dutch Indies, but it remains to be seen whether the company will now proceed with its application in view of the discussion which recently took place in the Chamber at the Hague. On that occasion it was submitted that either the company would make a profit out of the system, and if so, that the Government would enjoy the same advantage by making a State monopoly of wireless telegraphy in that part of the Dutch colonies; or, that if it was worked at a loss, the company would abandon the experiment, and no wireless system would exist in the Indies as at the present time. The granting of a concession would, it was urged, amount to co-operation on the part of the Government in the extension of the world monopoly for which the English company was striving, as it refused to accept messages from apparatus other than those of the Marconi type; and it was therefore contended that the Government should wait until the International Conference, to be held in Berlin in April, had cleared the position of affairs. In reply, the Minister for the Colonies remarked that the Berlin Conference had always been postponed too often for anyone to be really able to depend upon the meeting taking place in April. The concession proposed to the English company only related to communication between ships and the land. Other concessions, the Minister observed, could be granted, and provision for expropriation by the State would be made. The German Telefunken Co., on its part, could quietly make experiments on the Pulu Bras, in the Indian Archipelago, and telegrams transmitted by apparatus other than those of the Marconi Co. would have to be allowed. On this explanation the Dutch Chamber decided to reject a resolution in favour of a State monopoly of wireless telegraphy, leaving the question to be settled between the Government and the Marconi Co. on the lines foreshadowed by the Minister.

Helios reports that an attempt by the Indian Government to establish wireless telegraphy in Burmah between Diamond Island and Amherst, a distance of 212 miles, across the Irrawaddy Delta and the Gulf of Martaban, was not altogether successful, owing to atmospheric disturbances.

The De Forest Co. is introducing a "ship localiser," designed to indicate to a captain the distance of his ship from a danger point, and advise him of the direction of the rock or shoal.

Uruguayan Telegraphs.—The *Review of the River Plate* says that the Uruguayan Government has authorised the expenditure of $67,700 gold for repairing the National Telegraph lines, which suffered extensive damage during the recent revolution.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—January 17th. Overhead equipment for tramways. See "Official Notices" December 30th.

Belfast.—January 10th. The Corporation invites tenders *from local firms* for a system of synchronised dials; electric service lifts.

Belfast.—January 12th. The Public Health Committee is inviting tenders for an electric light installation (engine, dynamos, &c.) for the new Infectious Diseases Hospital, Purdysburn. Specifications (10s.) from the Town Clerk.

Belgium.—February 13th. Tenders are being invited until February 13th by the Municipal Authorities of Ghent for the supply of 15 electric cranes for use in connection with the docks. Tenders are to be sent to l'Hotel de Ville, Ghent, whence particulars may be obtained.

Bradford.—January 9th. Tenders are invited for the lighting of the Dudley Hill New Council Schools by electricity. Plans and particulars from Mr. Wilson Bailey, Tanfield Buildings, Market Street, Bradford.

Bradford.—January 16th. The Guardians invite tenders from electrical engineers for certain work at two hospitals at the Union Workhouse, Horton Lane, Bradford. George M. Crowther, Clerk to the Guardians, Union Offices, 22, Manor Row, Bradford.

Christiania.—January 10th. The Christiania Electric Works wants tenders for the supply of 1,000 tons of Cardiff coal, to be delivered at its yards by the end of February. Tenders marked "Anbud paa Kul," should be addressed "Kristiania Elektricitetsvœrks Kontor, Tordenskjolds Gade, Kristiania.

Halifax.—January 31st. Coal conveyor, shutes, &c., for the electric light and tramway power works. See "Official Notices" to-day.

Johannesburg.—January 26th. Vignoles rails, fishplates, rails, bolts, nuts, &c. See "Official Notices" December 23rd.

Johannesburg.—March 6th. 100 electric cars, two electric water cars, five-ton crane, car traverser, and workshop tools, for the Municipal Council. See "Official Notices" December 30th.

London.—January 16th. Tenders for a 750-KW. steam alternator with pipe connections, &c., for the South London Electric Supply Corporation, Ltd. See "Official Notices" December 23rd.

London.—January 24th. Fire alarm installation for the Northern Hospital, Winchmore Hill, N., for the Metropolitan Asylums Board. See "Official Notices" December 30th.

Ormskirk.—January 12th. The Guardians invite tenders for apparatus for electric lighting at their Workhouse, Wigan Road, Ormskirk. Steam piping and erection of plant, booster, storage battery, wiring of buildings and underground cables. Consulting Electrical Engineer, Mr. G. R. Peers, 16, John Dalton Street, Manchester. (Deposit two guineas.)

Port Elizabeth.—January 16th. Water-tube boilers, 400-KW. turbo-dynamos, mains, battery and boosters, switchboard, crane, public lighting, meters, workshop equipments and other plant, &c., for the Electricity Supply Undertaking. See "Official Notices" December 16th.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession of the exclusive right of the working of the tramways for collective transports of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Pudsey.—January 20th. Underground mains, junction boxes, switchboard, &c., for the Corporation. See "Official Notices" December 16th.

Roumania.—January 28th, 1905. Tenders are being invited by the municipal authorities of Guirgin for the concession for the electric lighting of the town.

Shanghai.—March 31st, 1905. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Swindon.—January 24th. One 30 ft. × 8 ft. Lancashire boiler, with superheater, piping, &c. See "Official Notices" December 30th.

Whitechapel.—January 12th. The Guardians invite tenders for the electric lighting of section No. 2 of the Infirmary. Specifications from the Clerk to the Guardians (one guinea). Consulting Engineers, the Electrical Standardizing Institute, 8 and 10, Charing Cross Road, W.C.

Whitechapel.—January 16th. The electric lighting of Section 2 of the Infirmary for the Guardians. See "Official Notices" December 30th.

CLOSED.

Belgium.—Four tenders were submitted to the Municipal Authorities of Charleroi for the supply and laying of the mains, transformers and electrical apparatus required in connection with the electric lighting station in the town, the lowest being that of La Société Belge d' Electricité, of Brussels, which quoted £10,560.

Dartford.—The U.D.C. has accepted the tender of Messrs. S. W. Gibson & Co., of Dartford, for the free wiring of consumers' premises.

Exeter.—The T.C. has accepted the tender of Messrs. Hodges Bros. for the equipment of the workshop at the electricity works, at £112.

France.—The French Post and Telegraph authorities in Paris have just given out contracts as follows:—M. Grammont, Pont-de-Cheruy, 150 kilometres of telephone cable (single conductor, rubber insulated and lead covered) at 370 frs. per kilometre, 150 tons of high-conductivity copper wire 2 mm. dia. at 2,280 frs. per ton, and 100 tons ditto 4 mm. dia. at 2,260 frs. per ton; La Société Alsacienne de Constructions Mecaniques, Belfort, 70 kilometres of lead-covered telephone cable (two conductors, rubber insulated) at 775 frs. per kilometre; Messrs. G. & H. de la Mathe, St. Maurice (Seine), 80 kilometres at 770 frs. per kilometre; the India-Rubber and Gutta-Percha Co., Persan-Beaumont, 20 kilometres ditto, but with 14 conductors at 3,490 frs. per kilometre; La Société Industrielle des Telephones, Paris, 30 kilometres ditto at 3,499 frs. per kilometre; La Compagnie Générale d'Electricité, Paris, 100 tons bronze wire $\frac{1}{10}$ mm. dia. at 2,905 frs. per ton; and 100 tons of high-conductivity copper wire 3 mm. dia. at 2,255 frs. per ton; Les Trefileries du Havre, 75 tons of bronze wire 1½ mm. dia. at 2,850 frs. per ton, 150 tons of high-conductivity copper wire 2½ mm. dia. at 2,264 frs. per ton, 200 tons ditto 4 mm. dia. at 2,242 frs. per ton; Les Trefileries de Rugles, Paris, 30 tons ditto 2 mm. dia. at 2,278 frs. per ton, and 40 tons of ordinary copper wire 1 mm. and 2 mm. dia. at 2,284 frs. per ton; La Compagnie Française des Métaux, Paris, 150 tons of high-conductivity copper wire 2½ mm. dia. at 2,252½ frs. per ton, and 150 tons ditto at 2,272½ frs.; Les Forges de Franche-Comté, 100 tons ditto at 2,270 frs. per ton; Les Mines et Fonderies de Pontgiband, 100 tons ditto at 2,247½ frs. per ton; and La Société d'Electro-Metallurgie de Dives, 100 tons ditto, at 2,240 frs., and 100 tons ditto, at 2,250 frs. per ton.

Gloucester.—The T.C. received the following tenders for the supply of an electric water sprinkler for the tramways:—

Dick, Kerr & Co., Ltd., Preston (accepted)	£550
British Thomson-Houston Co., Ltd.	557
Brush Electrical Engineering Co., Ltd.	565

Leeds.—The Corporation Hospitals' Committee has accepted the tender of the Magneta Co., of Winchester House, London, for the supply of their electric time system at the Seacroft Hospitals.

Stockport.—The Board of Guardians has accepted the tender of Messrs. Stroud & Co., of London, for the wiring of the new hospital for the electric light and the installation of telephones, at £773.

Trefriw (N. Wales).—Mr. H. Willoughby Lance, of Llandudno, has just received the contract to supply the street mains for the lighting of this place by the Llanrwst Electric Light Co. The work is to be carried out immediately.

FORTHCOMING EVENTS.

Monday, January 9th.—Institution of Mechanical Engineers (Graduates). Mr. A. O. Laird on "A Mechanical Method of Discharging and Storing Grain."

Tuesday, January 10th.—At 8 p.m. Institution of Civil Engineers. Address by Sir Wm. H. White, K.C.B., &c., on "The Recent Visit to the United States and Canada."

At 8 p.m. Institution of Electrical Engineers (Glasgow). Mr. H. B. Maxwell on "Street Lighting by Electric Arc Lamps."

Wednesday, January 11th.—At 7.30 p.m. Association of Engineers-in-Charge. "Gas Producer Plant and Gas Engines," by Mr. H. Allen.

Thursday, January 12th.—At 8 p.m. Institution of Electrical Engineers. Conclusion of Discussion on "The Combination of Dust Destructors and Electricity Works Economically Considered," by Mr. W. P. Adams; paper to be read by Messrs. W. H. Booth and J. B. C. Kershaw on "Fuel Economy in Steam-power Plants."

At 8 p.m. Tramways and Light Railways Association at the Society of Arts. Mr. H. M. Sayers on "Overhead Equipment."

Friday, January 13th.—At 8 p.m. Institution of Civil Engineers (Students). "Theory of Electricity and Magnetism," by Mr. James Swinburne.

At 7.30 p.m. Institution of Electrical Engineers (Students). Mr. A. E. Jepson on "Electric Heating."

Monday, January 16th.—At 3.30 p.m. (Oxford Circus Station). Tramways and Light Railways Association. Visit to the Central London Railway power station.

Tuesday, January 17th.—At 7.30 p.m. I.E.E. (Manchester). Mr. H. W. Wilson on "Electric Driving in Textile Factories."

Wednesday, January 18th.—At 8 p.m. Society of Arts. Captain L. James on "Wireless Telegraphy and War Correspondence."

At 7.30 p.m. I.E.E. (Birmingham). Meeting.

Friday, January 20th.—At 9 p.m. Royal Institution. Prof. Sir James Dewar on "New Low Temperature Phenomena."

Accident.—A heavy motor wagon belonging to the Southend Corporation dashed against a portable telescopic tower used in connection with the electric light standards last Saturday. The tower was smashed, and Cox, a Corporation employé who was on it, sustained serious injuries.

THE ELECTRICAL VOLUNTEERS.

THE following orders are issued for next week:—

Monday, January 9th.—"A" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m.

Tuesday, January 10th.—"B" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m.

Wednesday, January 11th.—Instructional drill, Westminster Hall, 8 p.m. Doors open 7.45. Plain clothes; rifles without slings.

Thursday, January 12th.—"C" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m. Lecture by Sapper Watsham on "Street Lighting Control Gear."

Friday, January 13th.—"D" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m.

Saturday, January 14th.—Week-end class.

J. J. F. O'SHAUGHNESSY, Captain.
For O.C.E.E.R.E. (V.)

NOTES.

The European Glow Lamp Syndicate. — Various difficulties have arisen in connection with the international glow lamp syndicate, which show that the organisation will not find it an easy matter to maintain its monopolistic position on the European continent, where it carries on business in Berlin as a company under the title of the Verkaufsstelle vereinigter Gluhlampen Fabriken. In the first place, differences took place between the constituents—German, Austrian, French and Dutch makers—and one of them proposed the dissolution of the combination several months ago, but this was rejected by the others, and the syndicate has continued in existence. Secondly, a Vienna firm has brought an action in the Austrian capital, and not in Berlin where the company is domiciled, in order to secure a declaration that the syndicate is invalid, owing to the withholding of agreements said to have been entered into in secret prior to its formation. The action is still proceeding, and the period of its termination seems uncertain. In the third place, the Compagnie Générale d'Electricité, of Paris, which is said to have been granted certain concessions for the French market, has withdrawn from the syndicate because the latter declined to accede to further demands which were put forward by the French company. The concessions have now lapsed, and the French market stands open for the syndicate to compete with the French company from the present time. In the fourth place, the Austro-Hungarian Association of Electricity Works, which represents all the lighting stations in those countries, has taken determined action against the syndicate, by the formation of a common purchasing bureau for glow lamps in order to present a united front in dealing with the syndicate. Some time ago the Association conceived the idea of erecting a lamp factory on its own account for the supply of the customers of the Austro-Hungarian lighting stations, but the proposal has been abandoned on the ground that such a factory would serve no special purpose on the possible collapse of the syndicate. On the other hand, it was shown that no capital expenditure would be needed in the establishment of a purchasing bureau, and that the latter would still be of benefit when the syndicate, where "ferment" has already begun, should no longer exist. The prospect of such a bureau being established is said to have resulted in concessions on the part of the syndicate, but as these are considered to be inadequate, the bureau has been formed in Vienna under the title of the Gluhlampen Einkaufs Genossenschaft for the purpose of enforcing, if possible, the claims of the lighting companies. The purchasing bureau intends to take steps to ensure that the lamps supplied by the syndicate fulfil the technical conditions in regard to lighting power, durability and economy in the consumption of energy, and testing places have been arranged for this purpose. The bureau, which has also already obtained certain concessions in prices, has been entrusted by the Austro-Hungarian lighting works with orders for meeting their lamp requirements down to the end of next September, in order that the ascertained quantity may then form the basis of one contract with the syndicate, if the latter should still be in existence at that period.

Fire- and Water-proof Dynamos.—To what extent modern electrical machinery will stand ill-usage is strikingly demonstrated by an incident that occurred recently in the United States. The New England Building at Cleveland, Ohio, is electrically lit throughout by a plant consisting of three Westinghouse 62·5-KW. engine-type generators installed in the basement, which, through some carelessness, recently became the scene of a rather serious fire. The temperature to which the machines were subjected was sufficient to completely burn away the insulation on the outside of the field coils; and for an hour they were played upon by six hose-pipes. Yet, within an hour after the extinction of the fire, the first of these machines was carrying its full load, and another followed suit in a short time, the two dealing with the entire lighting of the building that, under normal conditions, was negotiated with three machines. With the exception of the outer layer of the field coils, which was burnt away, the insulation was fire-proof and easily withstood a temperature that was sufficient to burn and blister the paint on the frames.

Heavy Motor-Cars.—The Local Government Board has agreed upon regulations for heavy motor traffic, which will come into force on March 1st. The Heavy Motor-Car Order, 1904, embodying these regulations, will be placed on sale shortly. The weight of a motor-car, unladen, is now raised to 5 tons. At the same time a corresponding increase is made in the limit on the joint weight (unladen) of the motor-car and trailer—namely, from four tons to 6½ tons. The total weight of car and load is limited to 12 tons, and the weight borne on any axle is not to exceed 8 tons, or the registered axle-weight. Special provision is made for the purpose of securing a proportionate width of tire and suitable speeds. The new regulations are made under Sec. 6 of the Locomotives on Highways Act, 1896, and consequently any breach of them will be punishable by a fine not exceeding £10.

South African Notes (from our Durban correspondent).—*East London (Cape Colony).*—When an electric car was descending Beach Hill on December 2nd last, an eye bolt in connection with the brake snapped, and the car rushed away at great speed. Instead of taking the curve at the foot, it left the track and ran straight on, dashing into a railing and coming to a standstill on the edge of a steep bank. A little further on it would have overbalanced and fallen on the rocks below. Fortunately, there were no passengers in the car.

Pietermaritzburg (Natal).—At a meeting of the Town Council on December 6th the tramway manager submitted estimates of the two proposed schemes for the Park extension. The cost of the two schemes was stated as follows:—

Scheme No. 1.—Track	£2,771
Poles, wires, feeders, &c.	900
Total	£3,671
Less material in hand	888
	£2,783
Scheme No. 2.—Track	£3,887
Poles, wires, feeders, &c.	1,100
Total	£4,987
Less material in hand	1,000
	£3,987

The manager recommended the adoption of No. 1 scheme, as it will be possible to use the discarded Vignole material, taken up from Railway Street. The Government engineer has inspected the site, and approves of the Vignole construction, which will be laid at the side of the existing road; provided the rails are kept flush with the ground. A further recommendation by the tramway manager was the letting of tram poles for advertising purposes, by which means an annual revenue of £600 was estimated. Both recommendations were approved of by the Council. The chairman of the Tramways Committee submitted the receipts from the tramways for the first month, November. The total receipts were £1,263 14s. 2d.; of this sum £867 13s. 1d. covers the expenses, and the remainder goes towards interest and depreciation.

Durban (Natal)—The report of the borough electrical engineer for the municipal year ending July 31st, 1904, has just been issued, and shows the very great progress that has been made in the electricity department, especially in the last two or three years. At present these works are the largest of any in South Africa, and have an up-to-date plant. The total units sold for the year 1898 were 184,111, but for the year under review they amount to 3,787,675 units. The increase is partly accounted for owing to the current supplied for the tramways. In 1898 there were 200 consumers, who this year number 2,586. There were 60 arc lamps used for street lighting in 1898, but there are now 250 arc and 900 incandescents. The revenue has increased from £5,846 to £69,053, while the capital cost per kilowatt compares very favourably with home towns. Since the introduction of electric trams the use of electricity for motive purposes has developed very largely, and the demand is still very great. The price charged is 2d. per unit, plus a standing charge of £5 per horse-power per year. The cost of generation for the tramways is shown at 1·37d. per unit, to which has to be added the interest and depreciation. The cost of current for private lighting is shown at 6·38d. per unit. The cost of street lighting per unit is given as 4·23d., which includes all charges.

Beware Gas!—The past week or two has been exceptionally trying to illuminating concerns, and it is, therefore, not surprising that the gas supply in the East-end of London should have failed in the hour of stress, leaving all those districts unprovided with the electric light in comparative darkness.

In Manchester, owing to the abnormal consumption of gas, it was necessary to curtail the street lighting to a considerable extent.

During the last week of the old year, two persons were suffocated through leaking gas in North London, a 3-in. gas main under the road having broken; in South London an eight-roomed house and its contents were wrecked by a gas explosion, the occupier being blown a considerable distance and seriously burned; in Hornsey Rise another residence and its contents were wrecked through a similar cause; a gas explosion occurred at the house of the American Consul at Cardiff, and at Bloxham, near Banbury, the manager of the local gas works was killed by a similar explosion. On the 3rd inst. an inquest was held at Lambeth on the body of Bernard G. Tayler, an electrical engineer employed by the L.S.W. Railway Co., who was suffocated by fumes from a geyser.

Mishap on the Central London Railway.—For several hours on Wednesday traffic was suspended on the Central London Railway between the City and the British Museum Station. While an empty train was being shunted at the crossover at the Bank Station, one of the cars "jumped" the metals.

A New Fire Alarm.—An evening contemporary says that an improved and very sensitive fire alarm has been brought out by a Danish inventor. It only acts when a sudden wave of heat is generated. A U-tube 4 in. high is filled with mercury, the upper parts containing sulphuric ether, and both ends being closed. One side of the tube is covered with a non-conducting material. An even and gradual rise of temperature warms the entire apparatus, but a sudden rise of temperature vaporises the ether under the unprotected glass, forcing down the mercury and ringing an electric bell by the closing of a local contact.

Lectures.—A course of three Christmas lectures, intended for juveniles, was begun at the London Institution on Monday, by Mr. Eric Stuart Bruce, on "Balloons, Airships and Flying Machines." In the course of his lecture Mr. Bruce explained his system of signalling by means of captive balloons, signals being given on the Morse or other code by the aid of a group of electric lamps in the interior of a balloon.

Appointments Vacant.—Assistant in charge of meter department at Hammersmith (50s.); second assistant electrical engineer for Bradford Corporation (£250); three assistants (one at £200 and two at £150) for the City and Guilds Electrical Engineering Department, Exhibition Road; switchboard attendant for Carlisle (25s.); mains superintendent for Partick (£120).

Para Rubber in Ceylon.—The success which has attended the experimental cultivation of the Para rubber tree in Ceylon and the Straits Settlements has attracted the attention of planters in all tropical countries suitable for its growth, and at the present time numerous plantations of the trees are being established in different localities. A series of articles in the *India-Rubber and Gutta-Percha Trades Journal* is summarised in the *Bulletin of the Imperial Institute* for September 29th, from which we obtain the following particulars:—Experiments have shown that in Ceylon the tree will thrive and furnish paying quantities of rubber when planted upon hill sides up to 2,700 ft., and it is still undecided whether its cultivation can be successfully undertaken at higher altitudes. The seeds are usually sown in nursery beds, situated upon good land which is fairly level and has a supply of water conveniently at hand. The average height of the plants when 10 months old, if the seeds have been sown 6 in. apart, is stated to be 6 ft. When the plants are about 5 or 6 ft. high they are transferred to their permanent positions, previous to which the stem is usually cut off about 18 in. above the soil, and has no leaves up to that height at the time of planting. From the results obtained in Ceylon it is suggested that the trees should be placed 15 ft. apart, giving about 200 trees per acre. Trees planted 30 ft. apart grow much faster and bigger than when they are closer together, but in this case there are only about 50 trees per acre, and the return per acre is considerably less. Trees planted 15 ft. apart have given an average yield of 1 lb. of rubber per tree. The trees are tapped for the first time in their seventh year, at which age a large proportion should have attained the necessary size of at least 18 in. in circumference. In Ceylon the usual method of tapping is by a series of V-shaped incisions, a tin cup being fixed below each in order to collect the latex. The incisions are made in vertical rows down the trunk, about 1 in. apart, and each limb of the V is from 2½ to 3 in. in length. Usually four rows of incisions are made, each of which contains 60 distinct cuts, making a total of 240. The tapping process is spread over a period of about two months, and it is claimed that this method yields much more rubber than the older practice of making a larger number of incisions at once. After four or six months' time the trees are again tapped, the new incisions being made between the previous rows. The results of tapping experiments show that a tree will give about 8 ozs. of rubber in its seventh year and 10 ozs. in the next; trees from 9 to 11 years old will, if carefully tapped, furnish 1½ lbs. per tree during the year, and there is no considerable average increase on this yield from trees 11 to 13 years old, as the latter give from 1½ to 2 lbs. of rubber per tree. The process employed for the preparation of the rubber from the latex is extremely simple. The latex is first strained through a sieve with fine mesh, in order to free it from all extraneous solid matter, and is collected in circular enamelled basins about 10 in. in diameter and 2 in. deep. The latex is allowed to stand without any addition until the next morning, by which time it has coagulated spontaneously, and the cake of rubber is found floating on the liquid. The cake is then lifted out and placed upon a sloping table to drain, the removal of the water being facilitated by pressure, first with the hands and finally with a wooden roller. The liquid which is expressed from the cakes is collected and allowed to stand for some time, when a further quantity of rubber separates, amounting to 1 or 1½ lb. for every 30 lbs. of cake rubber. After the water has been thoroughly removed from the cakes, they are placed upon sloping tables for about 48 hours, and while still soft they are usually branded with the name of the estate. The cakes are then transferred to wire trays for 24 hours, and are finally hung up on wires in a darkened room and allowed to dry until they are quite clear. "Biscuits" four to the pound require over three months to dry perfectly clear, if artificial drying is not employed, whereas if made eight to the pound the operation is complete in six weeks. For export the biscuits are usually packed in small boxes holding about 400 cakes or 50 lbs. of dry rubber. The quality of the rubber produced upon a certain estate is indicated by the fact that the average price obtained for all the rubber exported during 1903 was 4s. 4½d. per lb. It is estimated that to open up an estate of 200 acres in Ceylon with rubber trees, and to maintain it to the end of the sixth year, will cost Rs. 63,990 or about £4,200. Of this amount Rs. 28,990 is allotted for the first year's charges, whilst the subsequent upkeep is estimated at Rs. 7,000 per annum.

Electro-deposition of Cadmium.—A note published by Dr. A. Fischer in a recent number of the *Chemiker-Zeitung* describes an improved bath for the electro-deposition of this metal. Articles which have to be protected from rust, and to which it is not desired to apply a film of zinc—either because the latter is too brittle or too unsightly—may advisedly be given a coating of cadmium. Cadmium is negative to zinc, but positive to other metals, and it therefore prevents their oxidation, though not quite so powerfully as zinc. A layer of cadmium is very suitable for application to bridles, and other portions of horse harness constructed of iron. A better bath than that prescribed by Russell and Woolich is prepared by dissolving 32 grammes of cadmium chloride, or an equivalent quantity of any other soluble salt, in about 500 cc. of water, and adding an excess of a solution of sodium carbonate. A cadmium carbonate falls, which is almost normal in composition; it is well washed, and dissolved while still moist in a liquid containing 50 grammes of potassium cyanide per litre, warmth being employed to assist in the dissolution. The bath is used at a temperature of 40° C., with a cadmium anode, and a current of 4 or 5 volts. The deposit can be scratch-brushed, and polished on a greasy buffing wheel. It then has a tin-white colour, but is harder than that metal. Cadmium may also be applied to copper or brass objects, either alone, or in combination with other metallic deposits, &c.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Dartford U.D.C. has declined to grant any extra remuneration to Mr. A. J. C. WATERLAND, the late electrical engineer, in respect of extra services rendered in connection with the erection of special machinery. Mr. Waterland, in his application, stated that he had saved the Council something like £500, but the Council felt that, as Mr. Waterland had agreed to give his full time to the Council's work, the application should not be entertained.

Mr. A. WARDRUP, an assistant at the York electricity works, has received a better appointment at Elland.

At a meeting of the Bridgend Council last week, the resignation of Mr. F. C. WILLIAMS, the town's electrical engineer, was received and accepted, he having obtained an appointment in Natal.

Mr. W. L. THAIN has been promoted from the post of senior charge engineer to be station superintendent at the Newport (Mon.) power station, Corporation Road.

Mr. A. J. ABRAHAM, chief assistant, Partick, has been appointed chief electrical engineer to the Lanark County Council, to take charge of their electric light and destructor station at Cambuslang.

Tramway Officials.—Mr. A. A. BLACKBURN, A.M.I.E.E., car-sheds superintendent of the Manchester Corporation Tramways, has been appointed to the position of car works superintendent to the Belfast Corporation Tramways, at a commencing salary of £300 per annum. Mr. Blackburn has been with the Manchester Corporation Tramways for 2½ years. He takes up his new duties on February 1st.

Mr. HAROLD W. SEYMOUR has been appointed to the post of car-shed superintendent at Blackburn.

General.—Mr. WILLIAM JONES, the secretary of the Metropolitan District Railway Co., retires from active service as from Monday next, and the directors have appointed Mr. JOSEPH CARTER to succeed him.

On December 29th, at Oldham, Mr. SYDNEY HUMPHREYS, chief electrician for Kynoch, Ltd., Thames Factory, Essex, was married to Miss Annie Woodcock, of Royton, Lancs.

We understand that Mr. F. R. DAVENPORT, who for many years has been with the British Thomson-Houston Co., and latterly manager of their London office, has accepted a position with the firm of Peter Brotherhood, engineers, Westminster.

Sir WILLIAM J. COLLINS, M.D., D.L., J.P., chairman of the Education Committee, London County Council, will be the guest of the Municipal and County Club, Whitehall Court, at their next House Dinner on Friday, January 27th.

Mr. HAROLD F. DELL, managing electrical engineer to Messrs. Smirnoff & Sons, of St. Petersburg, was married on December 28th, to Miss May Lingard, youngest daughter of Mr. C. Lingard, of Annolovo, Pablofsk, St Petersburg.

Mr. STANLEY J LEECH has resigned his appointment with the British Electric Traction Co. as manager and engineer of their Weston-super-Mare and District Electric Supply Co. (lighting, power and tramways). He has held the appointment for five years, superintending all the original construction work, power house, mains, &c.; and later, the equipment of the tramways, and managing all departments. He has resigned in order to enter into partnership with Messrs. J. B. Saunders & Co., of 1, Palmer Street, Westminster, railway telegraph engineers and general contractors (established 1856). His new address is 1, James Street, Cardiff.

We are pleased to learn that Mr. BIRNBAUM, of the Berliner Telephone Manufacturing Co., who recently underwent an operation for appendicitis, is now well on the way to recovery.

Mr. MONTAGUE TABOR PICKSTONE, of Edinburgh, was married at Platt Church, Rusholme, on December 27th, to Grace Elizabeth, daughter of George Esdaile, Esq., The Old Rectory, Rusholme.

Mr. A. WALKINGTON has been granted an honorarium of £20 by the Stalybridge, Hyde, Mossley and Dukinfield tramways and electricity board upon the termination on December 31st of his engagement as chief clerk to the engineer-in-chief during the consulting period of three years.

Obituary.—The death took place on 2nd inst. at Lady Frere, South Africa, of Mr. ROBERT SIM, electrical engineer, at the early age of 29 years. On the completion of his apprenticeship he attended the Electrical College, Glasgow, under Prof. Jamieson, and later was appointed to the charge of the electrical works at the Clydebank shipbuilding yards. Thence he went to Brighton Corporation Electricity Works. He afterwards received the appointment of inspector of electrical mains in Edinburgh. While acting in that capacity his health failed, and, in the hope of recuperating, he took a situation at Falkirk as engineer at the new electrical station in that town. The exposure to which he was subjected while the works at Falkirk were getting into order weakened his system, and he went home to Aberdeen. In September, 1903, he went on a visit to Lady Frere, East London, and then to Kimberley, returning later to Lady Frere where he died.

We regret to record the death of Mr. FREDERICK ELKINGTON, of the firm of Elkington, Ltd., electroplate manufacturers. Mr. Elkington, who died on Monday at his residence near Kidderminster, was in his 79th year.

NEW COMPANIES REGISTERED.

Meadows, Teeton & Minshall, Ltd. (83,006).—This company was registered on December 23rd, with a capital of £1,000 in £1 shares, to acquire the business carried on by W. A. Meadows and H. W. Teeton, as "Meadows & Teeton," at 7-9, Albion Street, Hanley, and to carry on the business of electrical and mechanical engineers, manufacturers of, and dealers in, electrical, magnetic, telegraphic, telephonic and other appliances, makers of steam, hydraulic, pneumatic and other engines, generators, and suppliers of electricity, manufacturers of electric lamps and fittings, &c. The first subscribers (each with one share) are:—W. A. Meadows, Fenton Road, Hanley, electrical engineer; H. W. Teeton, 32, James Street, Stoke-on-Trent, electrical engineer; G. A. Minshall, 24, Bagnall Street, Hanley, electrical engineer; Mrs. L. C. Bagnall, 24, Bagnall Street, Hanley; Miss F. Horrobin, 32, College Road, Whalley Range, Lancashire; W. Teeton, Stafford Street, Hanley, draper; and Mrs. E. Meadows, Fenton Road, Hanley. No initial public issue. Registered without articles of association. Registered office, 7, Albion Street, Hanley.

E. P. Gascoigne & Co., Ltd. (83,020).—This company was registered on December 24th, with a capital of £3,000 in £1 shares, to adopt an agreement with E. P. Gascoigne and E. B. Wade, and to construct, lay down, establish, fix and maintain cables, wires, lines, accumulators, lamps and works for the generation, accumulation and distribution, and supply of electricity, and to carry on the business of electric lighting contractors, electrical engineers, electricians, &c. The first subscribers are:—E. P. Wade, Wembley Croft, Wembley, mechanical engineer, 750 shares; D. W. Forbes, 21, Greenhill Road, Harlesden, N.W., Colonial Bank official, 1 share; G. C. Hayes, Hallowen, Talbot Road, Wembley, clerk, 1 share; J. W. Dickson, 34, John Street, Bedford Row, W.C., solicitor, 1 share; L. C. Tree, 3, Penwortham Road, Streatham, S.W., managing clerk, 1 share; G. D. Moore, Avonhurst, Marlborough Road, South Croydon, electrical engineer, 1 share; and F. Hawksley, Cranleigh, Harcourt Road, Wallington, Surrey, artist. No initial public issue. The number of directors is not to be less than two nor more than five; the first are E. P. Gascoigne, managing director, and E. P. Wade, secretary; qualification, £500; remuneration as fixed by agreement.

Bergtheil & Young, Ltd. (83,061).—This company was registered on December 30th, with a capital of £40,000 in £1 shares, to acquire the business of electrical engineers and contractors carried on at 12, Camomile Street, London, and at Cleveland Buildings, Manchester, as "Bergtheil and Young," to adopt an agreement with the said vendors, and to carry on the business of manufacturers of, and dealers in, all kinds of electric, magnetic, galvanic, chemical, and other machinery, apparatus and appliances, &c. The first subscribers (each with one share) are:—A. Bergtheil, 12, Camomile Street, E.C., engineer; H. W. Young, 12, Camomile Street, E.C., engineer; E. Bergtheil, 12, Camomile Street, E.C., contractor; C. E. W. Ogilvie, 30, Budge Row, E.C., solicitor; S. G. Leach, 12, Camomile Street, E.C., engineer; J. W. Stourbridge, 12, Camomile Street, E.C., engineer; and A. G. Elliott, 12, Camomile Street, E.C., engineer. No initial public issue. The number of directors is not to be less than three nor more than five; the first are A. Bergtheil, H. W. Young, E. Bergtheil, and one other to be appointed by them; qualification, £1,000; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Totnes Electricity Supply Co., Ltd. (62,693).—This company's annual return was filed on November 30th, when 1,207 shares had been taken up out of a nominal capital of £10,000 in 10,000 shares of £1 each. £1 per share has been called up, and £1,200 has been received. £7 remains in arrears. No mortgages or charges.

Bullers, Ltd. (62,020).—This company's annual return was filed on December 28th, when 15,000 ordinary, and 15,000 preference shares had been taken up out of a nominal capital of £400,000 in 20,000 ordinary, and 20,000 preference shares of £10 each. £10 per share has been called up on seven ordinary, and £15,000 preference shares, resulting in the receipt of £150,070. 14,993 ordinary shares are considered as fully paid. No mortgages or charges.

Thompson, Ritchie & Co., Ltd. (35,835).—This company's annual return was filed on December 28th, when 200 preference, and 140 ordinary shares had been taken up out of a nominal capital of £5,000 in 200 preference, and 800 ordinary shares of £10 each. £10 per share has been called up on 170 shares, resulting in the receipt of £1,700. 170 shares are considered as fully paid. Mortgages and charges, £1,900.

Walsall Electrical Co., Ltd. (37,696).—This company's annual return was filed on December 16th, when 12,000 ordinary and 4,380 preference shares had been taken up out of a nominal capital of £25,000 in 25,000 shares of £1 each. £1 per share has been called up on 10,000 ordinary and 4,380 preference shares, resulting in the receipt of £14,380. 2,000 shares are considered as fully paid. Mortgages and charges: £4,000.

North West London Electric Supply Co., Ltd. (75,501).—Issue on December 7th of a 5 per cent. prior lien debenture for £10,000, part of series created August 4th, 1904, to secure £20,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No previous issue of same series. A trust deed dated December 7th, 1904, securing the above mentioned series of £20,000 prior lien debentures, has also been registered. Property charged: Leasehold hereditaments and premises known as 2, Rosemount Road, with fixed plant and machinery and fixtures thereon, the benefit of an agreement dated January 31st, 1896, and the company's goodwill, rights and general assets, present and future, including uncalled capital. Trustees: A. H. P. Strickland and P. A. M. Hoare, both of 37, Fleet Street, E.C.

Newcastle and District Electric Lighting Co., Ltd. (28,022).—Issue on December 16th of a 4 per cent. debenture for £250,000, part of series created January 30th, 1893, to secure not more than one-half the paid-up capital. Property charged: The company's undertaking and property, present and future, except uncalled or unpaid capital (as a first and floating security). Holders: Lloyd's Bank, Ltd., Lombard Street, E.C. No trustees. Previously issued of same series: £11,085.

Electric Lamp Renovating Co., Ltd. (77,552).—A debenture dated December 15th, 1904, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: R. C. Bell, 4-5, Warwick Court, Holborn, W.C.

ELECTRICITY SUPPLY AND TRAMWAY ACCOUNTS.

Wolverhampton Municipal Electric Lighting and Tramways.

COMPARED with the very substantial advances made during 1903, the returns of 1904 are somewhat disappointing. The increased output has not benefited the department's revenue appreciably. It is satisfactory to note that the working costs stand at the same total figure as in 1903 (despite increased output), and the gross profit is consequently a slight improvement on that year. After meeting financial charges, a balance remains on the year's working of £2,925 (including amounts provided against bad debts).

The prices charged are:—5d. and 2½d. per unit; power 2d. and 1d. per unit, maximum demand system; traction, 1½d. to 1¼d. per unit. Mr. C. E. C. Shawfield is the borough electrical and tramways engineer.

GENERAL STATEMENT.

For year ending March 31st—	1904.	1903.
Total capital expended	£145,415	£136,086
Number of units sold—		
Private lighting	1,099,172	926,634
Public lighting...	96,264	85,765
Traction	776,358	612,240
Total number of units sold ...	1,971,794	1,624,639
Equivalent No. of 8-C.P. lamps connected	64,382	54,578
Number of public lamps	55 arc 38 inc.	53 arc 22 inc.
Maximum load in KW.	1,295	1,190
Revenue account—		
Gross revenue	£21,700	£21,147
„ expenditure	£10,087	£10,087
„ profit	£11,613	£11,060
Average price obtained per unit—		
Energy per meter (lighting & traction)	2·55d.	3·04d.
Public lighting	3·22d.	3·75d.

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

Gross revenue	£21,700 =	2·64d. per unit.
Works and distribution costs (including public lighting)	£7,567 =	·92d. „
Total working costs	£10,087 =	1·22d. „

PROFIT STATEMENT.

Interest on loans, &c.	£4,415
Sinking fund	4,881
Interest, &c., accumulated	—608
Balance on year's working	2,925
Gross profit	£11,613

Wolverhampton's tramway returns are always of interest to the engineer, doubtless on account of their association with the Lorain system, to which, for better or for worse, the Corporation has pledged itself. Practically, this year's working differs little from its predecessor. The gross profit shows a decrease both in total and per car-mile, against which must be set somewhat improved total working costs—the result, however, being a smaller net balance than in the previous year.

The department wisely contributes some £3,200 towards a renewals account (amounting, with a previous balance, to £4,518), and hence creates a deficiency on the year's working.

Mr. W. A. Luntley is the tramways manager.

GENERAL STATEMENT.

For 12 months ending March 31st ...	1904.	1903.
Length of route...	10 miles.	7 miles.
Total length of track	13 „	11 „
Number of cars in use	15	14
Car-miles run	507,527	417,335
Passengers carried per annum... ...	4,555,435	4,263,066
Capital expended to date	—	£147,552
Total receipts	£23,523	£21,353
Working expenses	£14,911	£12,670
Gross profit	£8,612	£8,683
Income per car-mile	11·10d.	12·28d.
Working expenses per car-mile ...	7·05d.	7·28d.
Interest and sinking fund per car-mile	3·06d.	2·94d.
Total expenses per car-mile	10·11d.	10·22d.
Profit or loss per car-mile	+0·99d.	+2·06d.
Cost of energy per car-mile	2·53d.	2·80d.
Average fare per passenger	1·2d.	1·2d.
Revenue per mile of route	£2,352	£3,050
Expenditure per mile of route ...	£1,491	£1,810
Total units used...	776,358	612,240
Units used per car-mile	1·53	1·46
Percentage of working ex'es to receipts	63	59

PROFIT STATEMENT.

Interest, &c.	£3,917
Sinking fund	1,571
Sundry	1,000
Renewals fund, &c.	3,214
Deficit on year's working	—1,090
Gross profit	£8,612

CITY NOTES.

South Lancashire Tramways Co.

A BILL is being introduced next session by the South Lancashire Tramways Co. with reference to the financial position of the concern. It appears from the preamble that the South Lancashire Tramways Co, which has a very extensive system, is authorised under various Acts to raise capital to the extent of £1,450,000, and of this, £489,244 has been issued to the South Lancashire Electric Traction & Power Co., Ltd., which has constructed a large proportion of the tramways authorised by the Acts. In 1896 the Lancashire Light Railway Co., Ltd., got an order empowering them to construct a light railway from Liverpool to Prescot, and it has issued shares to the amount of £49,377 to the South Lancashire Electric Traction Co. The South Lancashire Electric Traction Co. has issued ordinary shares to the amount of £250,000, preference shares to the extent of £110,132, and debenture stock to the amount of £600,000; but, as the company was unable to pay the debenture interest, a receiver had been appointed. The South Lancashire Tramways Co. is seeking to acquire the assets of the Traction Co. and the undertaking of the Lancashire Light Railways Co., and to enable this to be done and also to enable authorised tramways to be constructed, the company wants power to rearrange its capital and to create and issue debenture stock.—*Financial Times.*

Cleveland and Durham Electric Power Co.

AN extraordinary general meeting of this company was to be held on Wednesday, at Middlesbrough, to consider resolutions for the creation of £156,000 debenture stock bearing interest at the rate of 5 per cent. per annum, to form part of the £333,333 which the company is empowered to borrow under the Act; also that the debenture stock be issued as soon as the power to issue becomes exercisable. Another resolution was to authorise the directors to dispose of the debenture stock on terms likely to be most advantageous to the company.

Manx Electric Railway Co.

THE report for the year ended September 30th last, showed that the gross receipts for the year amounted to £30,818, and the gross expenditure to £17,279; leaving the net earnings £13,539. Deducting from this the debenture interest (£8,963 13s. 6d.) and the amount placed to renewal fund (£1,000), there remained a net balance of £3,575 from this year's net earnings. Adding to this the amount brought forward from last year (£3,266), there was a disposable balance of £6,841. Out of this the directors had paid the preference dividend, amounting to £6,060 10s. 4d., leaving a balance of £780 8s. 6d., which they proposed should be carried to next year's account.

"During the year a large amount has been spent out of revenue in raising and ballasting the Douglas and Laxey track, and also the Snaefell Mountain track, and the whole line has been kept in a

good state of repair. Upon capital account there has been expended during the year £20,414 in the completion of the new generating plant and equipment, on rolling stock, erection of car-sheds, goods sheds and other works. The sum of £1,000 has in addition been set aside, out of revenue, towards a renewal fund. This year the company has had the benefit of the running of the generating plant, whereby the power costs have been greatly reduced."

Mr. E. Schenk presided on Tuesday at a meeting held at 78, Cornhill, and he said that during the past year some rather exceptional expenditure had been incurred, which it had been thought prudent to meet out of revenue. The outlay was mainly in connection with maintenance and renewal on the Snaefell Mountain track and other portions of the line which had been allowed to fall into an almost dangerous condition prior to the period at which this company took over the undertaking. The new generating plant at Laxey had been installed, and the result in respect of the power expenses had fully come up to expectations. A considerable addition had been made to the rolling stock, and new waiting rooms and refreshment rooms had been constructed at different points along the railway. It was disappointing that there was a decrease in the number of visitors to the Isle of Man, and the passengers carried over the line were about 85,000 fewer than in the previous 12 months. The stagnation in the cotton industry was particularly prejudicial to the prosperity of the Isle of Man. The average receipt per passenger last year was a fraction over 14d., so that if there had been no falling off in the number of passengers the revenue would have been about £5,000 higher.

The report was adopted.

Edmundson's Electricity Corporation.—The directors of the above company have declared an interim dividend of 5 per cent. per annum on the ordinary shares of this company, payable on January 14th, 1905, for the half-year ended September 30th, 1904.

City of Buenos Ayres Tramways Co.—The transfer of the undertaking of this company having now been completed in Buenos Ayres, the liquidators have decided to make the cash distribution of 30s. per share under the scheme, and also to convert the share capital and debenture stock of the City of Buenos Ayres Tramways Co., Ltd., into share capital and debenture stock of the City of Buenos Ayres Tramways Co. (1904), Ltd. Mr. John Heaton, the chairman of the City of Buenos Ayres Tramways Co. (1904), Ltd., has joined the board of the Anglo-Argentine Tramways Co., Ltd.

Electric and General Investment Co.—The warrants for the interim dividends on the 6 per cent. cumulative preference shares and of 10 per cent. per annum on the ordinary shares have been duly posted.

Chelsea Electricity Supply Co.—This company has deposited a Bill for introduction into Parliament next session to provide for the extinction of the 500 £1 founders' shares in the company. The founders' shares entitle the holders, subject to certain provisions as to the reserve fund, to one-third of the surplus profits of any year after the payment of a preferential dividend at the rate of 6 per cent. upon the ordinary shares. The *Financial Times* says that as a result of negotiations between the directors and the holders of founders' shares, an arrangement has been come to for the surrender of such founders' shares in consideration of the allotment and issue to the holders thereof of fully-paid ordinary shares in exchange for such founders' shares in the proportion of 10 fully-paid ordinary shares of £5 each for every founders' share, and it is expedient that this arrangement should be sanctioned. The Bill provides that on "the 30th day after the passing of this Act" the founders' shares shall be converted and the capital of the company reduced by £500.

Schattner Electricity Meter Co. — A meeting of this company was held yesterday at Upper Street, N., to confirm a resolution passed at the annual meeting changing the name to "Engineering Instruments, Ltd."

G.N. & C. Railway.—In regard to our weekly Traffic Returns table the returns of this railway have so far not included any amount in respect of G.N.R. season tickets.

STOCKS AND SHARES.

Wednesday Evening.

Most people interested in stocks and shares are somewhat disappointed that markets should not have moved more rapidly upwards than they did when the surrender of Port Arthur was announced. Investment securities were the quickest to feel the favourable influence, but even in these the first effect wore off partly upon the unfounded rumour touching an attempted assassination of the Czar, partly by reason of a heavy Irish land issue. Money has again become cheaper, and in the conventional words, that have a grimly ironical sound in these days of starving unemployed, it is a drug in the market. The price lists on the succeeding pages show that the demand for the highest-class stocks is keen, and several of the debentures now quoted *ex* interest have recovered all or part of the sum deducted.

Strings of dividend payments have been made during the last few days, and one feature of the week is this marking of stocks and shares *ex* dividend. Some part of this money returns to the market from whose issues it comes, and acts as a support through the fresh purchases made with the cash. The most prominent instance of recovery of dividend this week occurs in India-Rubber shares, which are still quoted 15½, *ex* 5s. per share. General Electric Preference are *ex* a similar sum, and at 9⅜ they, too, show no change. In the case of British Aluminium Preference shares, the distribution takes the share of £5 in Funding certificates. These are called 2½-3 for the £5 shares, and the dealers are buyers. British Aluminium Preference are accordingly marked down 2½ at 6¼. A smart rise in Brush Second Debenture took the price to 73½, equivalent to an advance of 4⅜, allowing for the 2¼ per cent. interest. There is a hint that the stock may be paid off, but we doubt the truth of this.

Amongst electricity supply shares, a fresh improvement has taken place in Metropolitans upon buying of substantial character, and at 18¼ the price is 25s. better. Some people are looking for a 10 per cent. dividend on the shares. Edmundsons added ⅛ at 6⅜, and the urban shares are both a trifle harder. About a dozen descriptions in this department are quoted *ex* their dividends or interest, without causing any alteration in price beyond, roughly speaking, the amount of the distributions. The time for dividend announcements in the case of the principal undertakings is nigh at hand, and expert opinion in the market assumes that the rates will not vary much from those declared about a year ago. If rumour speaks correctly, it is not unlikely that there may be several important new issues of capital offered before long. St. James's shares at 13⅜ have lost 5s.

Railway stocks leapt into popular regard just before the turn of the old year, and prices, though showing a disposition to slide back, are not badly maintained, taking the market as a whole. Central London Ordinary, in electrical stocks, has risen a point to 92. City and South London is also 1 per cent. firmer at 47. This time last year the Central London dividend was at the rate of 4 per cent., and the City and South London at the rate of 2 per cent. per annum. Central London Deferred, although carrying a full 12 months' dividend, continues dull at 85. There is a slight improvement in East London Ordinary at 5⅜. Districts are 40, and Metropolitan Consolidated 98½. The latter company's electric trains have commenced running between Baker Street and Harrow stations. Great Northern and City Preferred at 6¼ remain steady, and Speyer's certificates of the Great Northern and Piccadilly Ordinary shares are 9 middle.

The London Road Car Co. is offering its unissued share capital to its present proprietors at £6, the par value. The old shares are now 6⅛, so that there is very little indeed in the form of bonus to Road Car holders, whose money is asked in order that the company may institute a new service of motor-omnibuses. The vehicles plying at the present time between Hammersmith and Oxford Circus are attaining rapid popularity for their ease of travelling and their speed, and we suppose it will not be long before the London General Omnibus Co. makes large additions to its service of motor-'buses now running to Piccadilly.

Cape Electric Trams are weaker at 1 5/16 upon what is considered a disappointing dividend, but the Argentine varieties are decidedly strong. Anglo-Argentine Ordinary have risen to nearly 8, and the Preference at 5½ are *ex* 2s. 6d. dividend. Glowing accounts of Argentine prosperity have led to another burst of buying in Argentine Railway stocks, and the Traction shares participate in this strength to a reflected extent. City of Buenos Ayres Trams, however, are quiet at 10⅜, but Buenos Ayres and Belgrano advanced to 3 13/16, while the Preference are firm at 5⅜ and 5¼ for "A" and "B" respectively. Metropolitan Electric Trams Debenture is a good market at 103, equivalent to 105¼ with the interest, and London Uniteds are a shade up. Calcutta Trams attracted a fair amount of business in the vicinity of 8⅜, and British Electric Traction Preference rose ⅛ to 11.

Another violent fluctuation in Anglo-American Telegraph Deferred stock sent up the price a pound to 13⅜, and the Preferred put on ½ at 104½, taking the Ordinary a point higher to 58. The market is speculating as to the probable dividend for the final quarter of the year, and estimates talk of 35s. on the Preferred, making 5½ per cent. for the 12 months. Except for this activity, Telegraphs are quiet, but Telephones tend to improvement. Chili Telephones have hardened ½ to 6, and the two leading stocks of the National Telephone Co. advanced, the Deferred 1½ to 103, while the Preferred recovered the ½ that it fell last week. The 4 per cent. provisional certificates of the Debenture stock are all now fully paid, and are now quoted at the same price, 102½, as the older 4 per cent. Debenture stock.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Dec. 28th.	Closing Quotations Jan. 4th.	Business done week ended Jan. 4th, 1905. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	100 —103	99 —102 xd	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	1 — 1⅛	⅛— 1	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	56 — 58	57 — 59		
8,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	103¾ — 104½	104 — 105	104⅞	104
8,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	12½ — 13⅜	13⅛ — 13⅝	13⅝	12⅝
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5⅝ — 6	5⅞ — 6⅛	5⅞	..
15,338,300‡	Commercial Cable	£100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,200	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 96	92 — 94 xd	..	..
16,000	Cuba Telegraph	10	4 %	6¼%	5 %	8⅞ — 9⅛	8⅞ — 9⅛	9⅛	8¾
6,000	Do. 10 % Pref.	10	..	..	..	16½ — 17½	16¼ — 17½	..	..
12,931	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜ — 3⅝	3⅜ — 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	102 —104	100 —102 xd	..	..
60,710‡	Direct United States Cable	20	8½%	8½%	8 %	10⅜ — 11	10⅜ — 11	..	..
73,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	101 —103	101 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	135 —138	135 —138	137½	..
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	88 — 90	88 — 90	89½	88½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	10⅝	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	13½ — 14	13⅜ — 14	13⅝	13¼
820,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	106 —108	106 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	101 —103	101 —103	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	..	..
180,227	Globe Telegraph and Trust	10	6½%	£3 16 7*	5½%	10½ — 10⅝	10½ — 10⅝	10⅝	10 7/16
180,042	Do. do. 6 % Pref.	10	..	..	..	14 — 14½	14 — 14½	14½	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	28⅜ — 29½	28½ — 29	..	..
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	101 —103	99 —101 xd	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44½ — 46½	44½ — 46½	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	2½%	3 %	3 %	⅞ — 1	⅞ — 1	..	..
1,988,338	National Telephone, Pref. Stock	100	5 %	6 %	6 %	108 —109	108⅝ —109½	109⅛	108½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	101 —102	102 —104	103	102½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅛	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 7/16 — 5 7/16	5 7/16 — 5 7/16	..	..
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98 — 99	98 — 98 xd	97	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103¼ —104½	101½ —103¼ xd	102⅞	101½
1,000,000	Do. do. Prov. Certs., all paid	..	..	..	..	67½ — 68½	101½ —103¼ xd	..	..
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6¼%	1 — 1⅛	1 — 1⅛	1 1/16	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛ — 1¼	1⅛ — 1¼	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 —100	96 — 99 xd	..	..
11,889	Reuter's	8	5 %	5 %	..	7 — 7½	7 — 7½	..	..
8,808	Submarine Cables Trust	Certs.	..	..	..	120 —123	120 —123	120½	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6⅝ — 6⅞	6¼ — 6⅝ xd	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5⅛ — 5⅜	5 — 5⅛ xd	5⅞	5⅛
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	106 —108	104 —106 xd	..	..
18,609	West African Telegraph, Shares	10	..	2 %	4 %	7½ — 7¾	7½ — 7¾	7⅝	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	3/8 — 7/16	3/8 — 7/16	7/16	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	98 —100	97 — 99 xd	..	..
967,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	13½ — 14	13½ — 14	13⅝	..
75,000‡	Do. do. 5 % Debs. 2nd series, 1908	100	..	..	..	103 —105	101 —103 xd	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	100 —102 xd	..	..
88,321	West India and Panama Telegraph	10	..	..	..	⅜ — ½	⅜ — ½	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅜ — 7⅝	7⅜ — 7⅝	7 13/32	7⅜
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	6½ — 7½	6½ — 7½	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	103½ —105½	101 —103 xd	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	8½ — 9	6 — 6½xd	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	9 — 9½	9 — 9½	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 — 100	96 —100	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅞ — 10⅛	9¼ — 10 xd	10	9 1/16
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10 1/16 — 10 1/16	10⅞ — 11⅛	10⅛	..
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —119	118 —120	118½	..
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	95 — 97	96¼	96½
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5¼ — 5⅜	5¼ — 5⅜	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅜ — 5⅝	5¼ — 5⅝	..	..
60,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —105	101 —104 xd	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅜ — ½	⅜ — ½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	69 — 73	72 — 75 xd	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9¼ — 10	9¼ — 10	9½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	103 —105 xd	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	90 — 92	91 — 93	91¼	91
494,998	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	101½	....
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	84 — 86	84 — 86	..	..
1,330,000	City and South London Railway	Stock	2 %	3½%	2¾%	45⅛ — 46⅛	46⅛ — 47⅛	47	..
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1⅞ — 2	1⅞ — 2	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	94 — 99	93 — 98 xd	98½	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	⅜ — ⅞	⅜ — ⅞	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..
844,023‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	78 — 83	77 — 82 xd	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	lectric Construction 1 to 112,100	2	6 %	6 %	4 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —100	98 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¼ — 10	9¼ — 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10⅛ — 10⅜	10⅛ — 10⅜	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	110 —112	110 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	15 — 16	15 — 16 xd	15⅛	15 1/16
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	99½	..
87,500	†Liverpool Overhead Railway, Ord.	10	1¼%	1¼%	..	3 1/16 — 3 3/16	3 1/16 — 3 3/16	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	38 — 40	38 — 40	38⅞	..
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	103 —105	101½ —103½	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	88 — 90	90 — 92	89	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued). – ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Dec. 28th.	Closing Quotations Jan. 4th, 1905.	Business done week ended Jan. 4th, 1905. Highest.	Lowest.
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	‡ £	8⅝	8 %	10 %	10¼– 11	10½– 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10½– 10⅝	10½– 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	104 –107	104 –107	..	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	10 %	8 %	8¼– 8⅜	8¼– 8⅜	8⅜	..
70,000	Do. do. 4½% Cum. Pref. ..	£	..	..	..	5 9/16– 5 11/16	5 9/16– 5 11/16	5 11/16	5 9/16
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	5 – 5⅛	4 7/16– 5 xd	..	..
40,000	Do. do. 1903	£	..	..	..	5 – 5⅛	4 7/16– 5	5	4 15/16
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 –103	101 –103	..	..
44,486	*Chelsea Electricity Supply, Ord.	£	4 %	4½%	5½%	6⅜– 7	6⅜– 6⅞	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 –111	107 –109 xd	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	5 %	10¾– 11¼	10¾– 11 1/16	11 1/16	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13½– 14	13½– 14	13¾	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	123 –127	121 –125 xd	124	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	103 –105	101 –103 xd	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	4 %	9 – 9¼	9 – 9¼	9¼	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	..	..	..	12 – 12½	12 – 12½	12 5/16	12⅛
400,000£	Do. do. 4½% Deb. Stock	..	..	..	..	107 –110	106 –109 xd	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 –103	101 –103	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	7 %	6½– 6⅝	6¼– 6½	..	..
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 – 6¼	6 – 6¼	6 5/16	..
300,000£	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	107 –109	108 –110	109	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	10 %	12%	12¼– 13	12½– 13	12⅝	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 –104	102 –104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	..	2⅛– 2⅜	2⅛– 2⅜	2¼	..
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5 9/16– 5 11/16	5 9/16– 5 11/16	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	95 – 97	95 – 97	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	6½%	7½%	8½%	16⅜– 17¼	18 – 18½	18⅜	17½
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5¼– 5⅜	5 7/16– 5 9/16 xd	5 9/16	..
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	112 –117	110 –115 xd	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 – 99	96 – 98 xd	..	..
10,862	Notting Hill Electric Lighting	£	5 %	6 %	6 %	14½– 15	14½– 15	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	101 –103	102 –104	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	13⅞– 14¼	13¾– 14	14	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	..	..	..	8⅞– 9	8⅞– 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	99 –101	98 –100 xd	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	..	2½%	4 %	2⅞– 3⅛	2⅞– 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 – 87	83 – 87	..	..
65,000	South London Electricity Supply, Ord.	£	..	1¾%	3 %	4⅛– 4⅜	4⅜– 4⅝	..	..
100,000	South Metropolitan Electric Light and Power Ord.	£	..	..	..	1/16– 1/8	1/16– 1/8	..	..
50,000	(Late Blackheath and Greenwich Dist. E.L.Co.) 7 % Pref.	£	..	..	..	1⅛– 1 1/16	1⅛– 1 1/16	..	..
100,000	4½% 1st Deb. Stock	100	..	..	..	107 –110	107 –110	108¾	..
80,000	Urban Electric Supply, Ord.	£	..	..	..	4½– 5 1/16	5 – 6⅛	5 5/16	..
80,000	Do. do. 5 % Cum. Pref	£	..	..	..	5 – 5⅝	5 1/16– 5 7/16	5 7/16	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..	100	..	..	..	104 –106	104 – 106	105⅝	..
110,000	Westminster Electric Supply, Ord.	£	10½%	12 %	13½%	12⅜– 13⅛	12⅜– 13⅛	13	12 3/16
28,141	Do. do. 5 % Cum. Pref.	£	..	..	..	6½– 6⅝	6 – 6½ xd	6 7/16	6⅜

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, January 4th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£23	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	8d.	..
a ,, Caustic (75/80%)	per ton	£19	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots	per ton	£168	..
b ,, Sheet, in ton lots	per ton	£166	..
b Babbitt's metal ingots	per ton	£48 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	..
c ,, Tube (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn)	per lb.	8¾d.	..
c ,, Wire, basis	per lb.	7¾d.	..
c Copper Tubes (brazed)	per lb.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	10½d.	..
c Copper Bars (best selected ..	per ton	£80	£1 inc.

METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g Copper Sheet	per ton	£80	£1 inc.
g ,, Rod	per ton	£80	£1 inc.
e ,, (Electrolytic) Bars ..	per ton	£70 10	..
e ,, Sheets ..	per ton	£87	..
e ,, ,, Rod ..	per ton	£81	..
e ,, ,, H.C. Wire	per lb.	9¼d.	..
f Ebonite Rod	per lb.	3/8	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/11½ to 5/0⅜	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	51/-	2/7 inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£13 2 6 to £13 5	inc.
g ,, ,, Sheet	per ton	£14 10	2/6 inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 15	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/04 to 1/8	..
p ,, rolled bars & rods	per lb.	1/0½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/2	..
o Platinum	per oz.	21/6	..
e Silicium Bronze Wire	per lb.	10d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£132 10 to £133 10	30/- dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/8	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£48 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 8 ply 10 lbs. Russian ..	per lb.	4 13/16d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¾d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne brd.)	per ton	£29 7 6	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.. *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.: *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

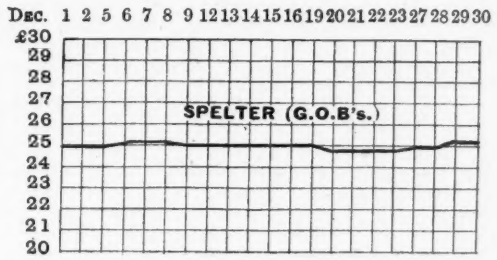
ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

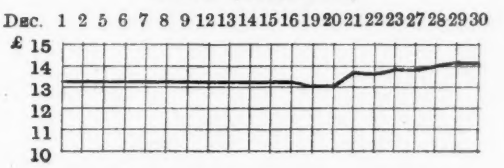
	Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	No. wks.	Total to date. £	Total to date. £*	Miles open.	*
Brit. Elec. Trac. Co.	Aberdeen	Dec. 24	1,147	— 28	30	42,834	+ 5,687	10	—
	Bath	,, 28	727	—	52	32,986	—	12½	—
	Birmingham ..	,, 31	5,601	+295	53	285,160	+15,885	8½	—
	Blackburn	,, 9	738	+ 1	36	34,879	+ 3,334	13½	—
	Blackpool	,, 29	337	+ 1	39	43,512	+ 5,937	8½	—
	,, —Fleetw'd	,, 31	224	—	26	21,322	+ 406	7½	—
	,, —Lytham	,, 29	137	— 38	9	1,109	—	7½	+ ¾
	Bolton	,, 25	1,626	—258	39	71,599	+ 298	25	—
	Bournemouth ..	,, 28	1,031	+ 35	39	43,210	—	10½	—
	Bradford	,, 17	3,729	+363	35	169,463	+27,081	54	—
	Brighton	Jan. 1	904	+175	39	40,453	—	9	—
	Bristol .. .	Dec. 30	5 546	+708	—	—	—	28	—
	Devonport ..	,, 23	502	— 56	51	26,903	+ 3,158	5	—
	Dudley—Sto'rb'ge	,, 23	675	—131	51	43,847	+ 1,235	18⅔	—
	Gateshead ..	,, 23	897	—163	51	46,332	+ 1,225	10½	+ ¾
	Gr'n'k—Pt. Glsgw	,, 23	514	+ 17	51	29,232	+ 1,465	7½	—
	Oldham—Ashton	,, 23	413	—154	51	27,685	— 1,267	5	—
	Potteries	,, 23	1,621	—286	51	87,647	+ 5,827	28⅔	—
	South Staffs. ..	,, 23	621	—438	51	38,642	— 8,717	21½	— ¾
	Swansea	,, 23	451	—148	51	27,339	+ 762	5½	—
	Wolverhampton ..	,, 23	331	— 38	51	19,729	— 93	10½	+8
	Yorks. Wool Dist.	,, 23	460	—168	51	29,438	+ 8,770	6	—
	Miscellaneous ..	,, 23	2,665	—	51	179,787	—	—	—
	Burnley	,, 31	1,089	+232	—	—	—	10⅔	+2⅔
	Burton-on-Trent ..	,, 25	262	— 87	38½	13,272	—	8½	—
	Cardiff	,, 24	2,013	—120	38	78,579	+ 1,642	14	
	Chatham & District	,, 22	496	—125	51	29,577	+ 1,966	9·33	+·80
	Cork	,, 22	446	— 86	51	28,764	— 2,516	9·89	—
	Dover	,, 31	214	+ 35	52	11,198	— 228	8	—
	Dublin	Dec. 30	4,908	+623	—	132,113	— 1,945	47	—
	East Ham	,, 31	680	+ 91	39	28,292	+ 1,521	6⅔	—
	Glasgow	,, 31	14,109	—856	31	440,697	+20,009	72½	+ 3
	Halifax (2 weeks) ..	,, 28	2,498	+121	39	57,844	+ 4,192	34½	+ 3
	Huddersfield ..	,, 17	1,170	+ 62	37	50,417	+ 3,090	28	—
	Hull	,, 31	2,302	—162	39	86,315	+10,619	13	—
	Ilkeston	,, 28	120	— 18	39	5,414	— 378	3·5	—
	Ipswich	,, 31	442	+ 54	39	19,122	—	10½	—
	Isle of Thanet ..	,, 31	314	+ 32	52	31,901	+ 1,676	10½	—
	Leeds	,, 31	5,747	+477	40	231,541	+12,832	89½	+8½
	Liverpool	,, 24	10,473	+365	52	537,171	+14.280	108	—
	London C. C. ..	,, 17	12,455	+3113	37	477,073	+103·99	47½	+7⅔
	Manchester	,, 31	11,972	+838	39	479,487	+19,617	137½	+12½
	Newcastle	,, 24	3,671	+331	—	—	—	17	—
	Portsmouth	,, 17	1,487	+ 68	38	71,443	+ 5,792	14½	—
	Salford	,, 26	3,710	—374	38	157,186	+ 7,604	30	—
	Sheffield	Jan. 1	5,191	+571	41	187,626	+ 4,161	34½	+1½
	Southampton ..	Dec. 29	918	+107	39	38,657	— 2,316	16½	—
	Southend-on-Sea ..	,, 28	223	+ 25	39	14,416	+ 1,430	6½	—
	Sunderland	,, 18	1,116	+ 44	37	47 804	+ 1,092	21	+1
	Tyneside	,, 28	367	+ 40	52	20,016	+ 3,340	8·9	+ ·4
	West Ham	,, 29	1,261	—	44	42,039	—	9·78	—
	Wolverhampton ..	,, 14	663	+277	—	—	—	9·5	—
	Cen. London Rly. ..	,, 31	6,296	—295	26	169,346	+ 719	6	—
	City & S. Lon. Rly.	Jan. 1	3,221	— 51	1	3,221	— 51	6½	—
	Dublin—Lucan Rly.	Dec. 31	158	— 18	26	3,278	— 17	6½	—
	G. N. and City Ry.	,, 31	1,487	—164	46	49,015	—	3½	—
	L'pool Overh'd Rly.	Jan. 1	1,433	—180	27	1,433	— 180	6½	+4½
	Mersey Railway ..	Dec. 24	2,138	+ 599	25	87,872	+ 3,843	4½	—

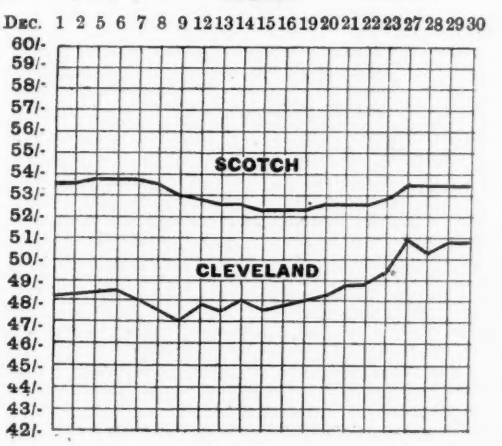
* Compared with the corresponding period of 1903.

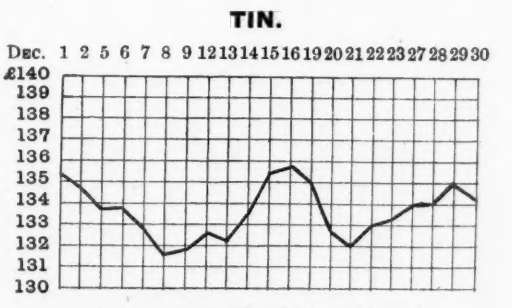
METAL MARKET.

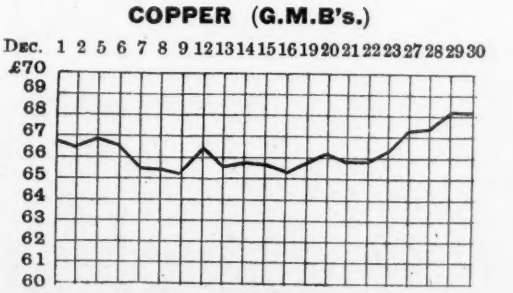
Fluctuations in December.











Philippine Islands.—The Manilla Electric Railroad and Light Co. will have 40 miles of single track ready for operation on March 1st. The construction and equipment of this line will represent an outlay of nearly one million sterling.

INSTITUTION OF ELECTRICAL ENGINEERS

THE MEASUREMENT OF VACUUM.

By C. Turnbull.

(*Abstract of Paper read at Newcastle, December 12th*, 1904.)

While this is becoming one of the most important things in the whole station, its measurement at present is obtained in a most unsatisfactory and indirect manner. The vacuum gauge in common use measures the difference between the condenser pressure and the atmospheric pressure. It is, therefore, necessary to read the barometer as well as the vacuum gauge to get at the true result. What we require is an instrument which will fulfil the following requirements: (1) It must show the actual pressure in the condenser quite independently of the pressure of the atmosphere; (2) It must be quite accurate in its readings, and not liable to go wrong.

The first requirement would be met by an ordinary Bourdon gauge with an *exhausted* tube (or a similar arrangement to that used in the aneroid barometer), but with the *case* of the instrument connected to the condenser. This will measure the actual pressure at the exhaust, quite independently of the pressure of the atmosphere. Another and perhaps better way is to make use of the ordinary mercury barometer, only it must be connected up properly. As ordinarily used (fig. 1) the mercury column balances the difference between the condenser pressure and that of the atmosphere. If

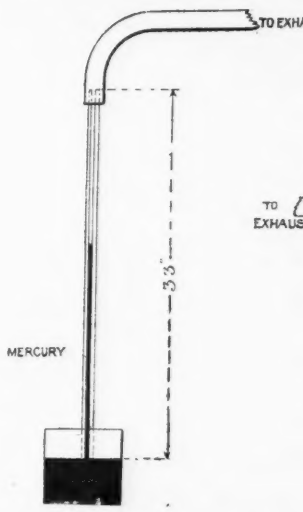


Fig. 1.

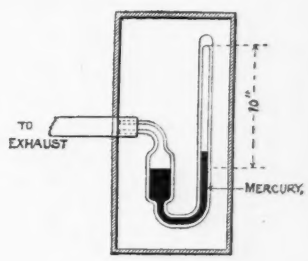


Fig. 2.

we connect up as in fig. 2, the mercury column will show simply the actual pressure in the condenser, and quite accurately. When the mercury rises 4 in. in the tube, it means that there is a pressure in the condenser which has an effect upon the back of the piston of a reciprocating engine as if the piston were lifting a layer of mercury 4 in. deep. For most purposes with the fig. 2 instrument, a 10-in. tube is quite long enough, for this will show a vacuum as low as 20 in.

It is to be noted that the reading of any vacuum gauge is materially altered by its position. If it be placed low down, then water will collect in the tube leading to it, and the weight of the column of water will affect the reading. Probably this fact often accounts for the difference of reading between the gauge on the engine exhaust pipe and the gauge on the condenser, as much as the drop of pressure between the two due to loss in the connecting pipes.

Seeing the enormous importance of good vacuum with large turbines, I have thought that the subject would prove worthy of your interest.

HIGH-TENSION SWITCHGEAR.

By L. Andrews, M.I.E.E.

(*Abstract of Paper read at Manchester, December 13th*, 1904.)

One or two serious accidents with high-tension switchgear of compact design have made engineers realise that, efficient and convenient though such switchgear has shown itself to be under normal conditions, the margin of reliability must be further increased in view of the paramount importance of preventing interruptions in the supply of current.

The most revolutionary departure from former practice, to be found in nearly every switchboard that has been erected during the past year, is the dividing of the controlling system up into a number of entirely separate units, each section being so isolated from adjacent sections as to render a spread of fire from one unit to another practically impossible. This entails the operation of switches placed at a distance from a central operating panel or keyboard.

American practice has tended towards the almost universal adoption of electrical control, while on the Continent the tendency has been to favour mechanical control. An excellent example of this is the switchgear controlling the 13,000-volt generators, &c., at Paderno, which has now been in successful operation for about seven years.

One argument that is sometimes used in favour of electrical control is that a large mechanically operated three-phase switch cannot be closed sufficiently quickly for synchronising. This argument certainly does not apply to 1,000-KW. generators or under.

Again, we are told that mechanically-operated switches must be tripped electrically, and might as well be operated electrically entirely. But merely to trip a switch that is closed by hand, is a very simple problem compared to that of constructing a switch to be opened and closed electrically.

Another advantage claimed for electrical control is that it enables the high-tension switches to be placed directly opposite the generators they control, as the operating keyboard can be compactly arranged in a very small space, but even this is a doubtful

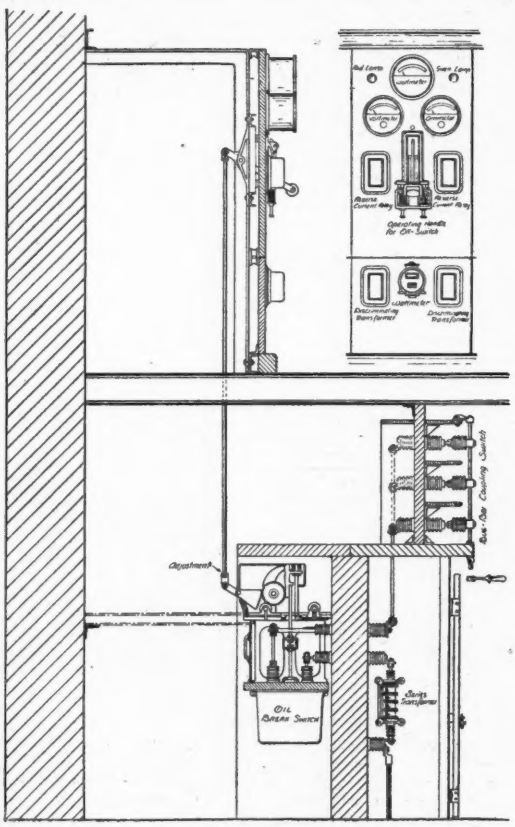


FIG. 1.

advantage. It seems much better practice to bring the main cables from the generators to one point of the building, at which centre all the high-tension switches are placed.

Electrical operation is certainly more satisfactory for controlling switches placed a long distance from the operating board.

So far we have considered the question of mechanical *versus* electrical control in the abstract only. A brief description of the 6,000 volt mechanically-operated boards, now in course of erection at Poplar, will show how the problem has been dealt with in this case.

Fig. 1 is a sectional view of the high tension board in the main generating station. The construction and arrangement of the high tension boards in the sub-stations is precisely similar.

The three-phase high-tension oil break circuit-breakers are fixed in brickwork cells on the ground floor. Each unit or section is by this means efficiently isolated from adjacent sections, and a spread of fire from one section to another is rendered practically impossible.

As this confining in narrow brick cells is apt to make some of the back connections inaccessible (and the importance of accessibility cannot be over-rated) provision has been made for withdrawing each circuit-breaker from its cell for overhauling, cleaning, and inspection. For this purpose the circuit-breaker is mounted on rollers, which rest on brackets fixed to the partition walls of the cells. Extension rails are provided, along which the circuit-breakers may be withdrawn.

The connections at the back of the circuit-breaker cells, together with the series transformers from which current for the instruments and relays, &c., is obtained, are also enclosed in brick cells.

No high tension cables are carried into the circuit-breaker cells, the necessary connections being made by copper rods carried through insulators set in the wall.

A detail to which considerable attention was paid in designing this board, is the arrangement of the bus-bars. Each bus-bar is isolated from adjacent bus-bars by horizontal slate slabs, and to guard against any risk of an arc being formed that might destroy this slab, and so short-circuit the bars, precautions have been taken that effectually obviate any possibility of the circuit being opened in either of the bus-bar compartments.

Isolating plugs are provided to enable any circuit-breaker to be completely disconnected from the bus-bars, before working upon it. These plugs should, of course, not be removed when carrying current. In the event, however, of an attendant withdrawing a wrong plug by mistake the circuit will not be broken in the bus-bar compartment, but on the other side of a thick stone slab. As the back contact plugs are again isolated from the contacts of other phases (in this case by vertical slate slabs), the damage is bound to be confined to that particular contact. As a further precaution, the plugs are so constructed that they cannot be withdrawn more than 2 in. from the back contacts, so that should an arc be started it will not be a long and destructive one, and the attendant will thus be able to replace the plug and open the main circuit-breaker before much damage is done.

Another question upon which opinions differ at present, is that of the necessity of separating the contacts of one phase from those of opposite phases in the main circuit-breakers. Some engineers consider that if the circuit is broken under oil the contacts of all phases may be contained in one vessel. Others go to the opposite extreme, and divide each phase from adjacent phases by brick walls.

It appears, however, that all that is actually required is that the contacts of the different phases should be contained in separate oil tanks, the latter being insulated from the high tension connections and from earth.

It is no longer necessary to draw attention to the fact that neither fuses nor excess-current circuit-breakers should be used between generators and the main bus-bars, but that reverse-current circuit-breakers should be used in this position. Nearly every switchboard that has been erected during the past year has been so equipped. The only danger now is that alternating current discriminating devices will be brought into disrepute, through being misunderstood. Experience has shown that some of these devices are capable of behaving in a most unexpected manner under the abnormal conditions that are liable to arise when a serious breakdown on any part of the system occurs.

As long as a generator is supplying current to feed a non-inductive load, the phase relations between current and E.M.F. will be as indicated respectively by the curves I and E, fig. 2, and by compounding these curves we obtain the curve W, representing the torque or pull due to these combined forces. This pull may obviously be used to hold the cut-out in its closed position. If now one of a number of generators working in parallel should fail—due, say, to a bearing seizing—current will flow into this generator, tending to drive it as a motor, and this current will be approximately 180° out of phase with the bus-bar E.M.F. That is to say, the phase relations will now be as shown in fig. 3. We see that the direction of the pull is now reversed, and it may therefore be used to release the cut-out.

Let us now suppose that a generator, protected by cut-outs constructed as above, loses its field; current will again feed back into it from the bus-bars and other generators, but this current will not be 180° out of phase with the bus-bar E.M.F., because its energy is not in this case expended in driving the faulty generator as a motor. The speed of this generator is being maintained by its engine. It is evident, therefore, that the reverse current must, under these conditions, be practically wattless. The phase conditions may now

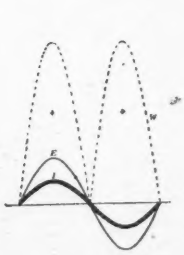


FIG. 2.

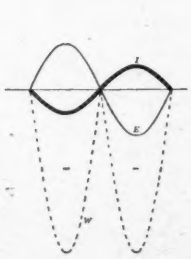


FIG. 3.

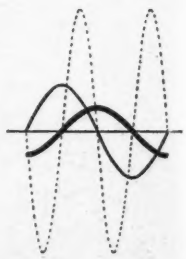


FIG. 4.

be represented by the curves shown in fig. 4. It will be seen that the current curve is approximately 90° in advance of the E.M.F. curve, and the pull or torque is alternatively positive and negative, and being just equal and opposite, their combined effect is nil for any current.

A device designed to deal with a reverse current, due to a failing prime mover, is thus useless for isolating a generator having an open circuited field.

By adjusting an inductive resistance in series with the shunt circuit until the shunt current lags about 45° when the series current is feeding a non-inductive load, the phase relations in the cut-out device are altered to those shown by the respective curves in fig. 5, A representing the conditions when the generator controller is feeding a non-inductive load, B when the prime mover fails, and C when the generating field is open circuited.

We have always felt that no discriminating circuit-breaker, that failed to comply with the following conditions could be considered a satisfactory protective device:—

(*a*) An alternating current discriminating cut-out must not be released by a low resistance short-circuit beyond the cut-out.

(*b*) It must not be released by a current supplied to a highly-inductive load beyond the cut-out.

(*c*) It must not fail to be released should the prime mover driving the generator controlled, be pulled up by a hot bearing or similar failure.

(*d*) It must not fail to be released should the field of the generator controlled, break down.

(*e*) It must not fail to be released by a very heavy reverse current, even should the pressure across the bus-bars drop to as low as 20 per cent. of normal pressure.

There are other conditions equally important, but it will generally be found that a device that complies with all the above is also capable of dealing with the other conditions.

[To show how extremely difficult it is to design an alternating current device to comply with all of these requirements, a number of

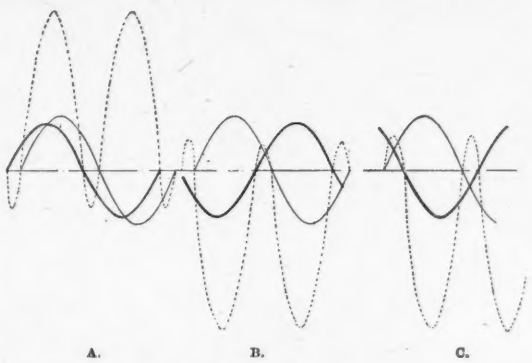


FIG. 5.

experiments were then carried out, with seven discriminating devices, each one of which depends for its action upon an entirely different principle to that of the others. The principles upon which the majority of these devices work have been explained in the ELECTRICAL REVIEW, June 3rd and 10th, 1904.]

In particular, fig. 6 is a simple differential solenoid, the two windings of which are connected in parallel across any low tension source of supply A—B, excited from the main bus-bars. These windings are parallel on one side through a small equaliser, upon which is wound one turn of the cable between the generator to be controlled and the main bus-bars. So long as there is no current in this series turn, the current from the low tension source of supply divides equally between the bottom and the top winding of the differential solenoid, and its core is in consequence neither pulled

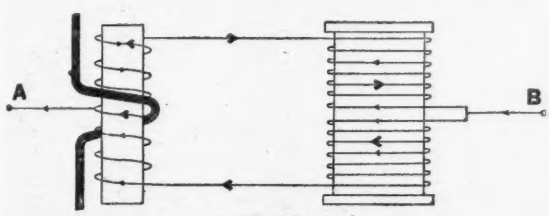


FIG. 6.

up or down, but is held down by gravity. A generating current in the series turn will destroy the balancing effect of the equaliser, causing more current to flow through the lower coil and less through the upper coil of the differential solenoid, with the result that the core will be held down magnetically as well as by gravity. A reversal of the series current will induce more current to flow through the upper coil and less through the lower one, thus lifting the core and releasing the cut-out.

Here we have only two influences to consider. In the first place we have a simple series transformer, the secondary of which is closed through two solenoids connected in series; and, in the second place, we have two parallel circuits of equal ohmic and inductive resistance connected across a source of potential supply. When the induced secondary potential and the applied potential are in phase with each other, they will oppose each other in the upper winding of the differential solenoid and reinforce each other in the lower winding. When the respective potentials are 180° out of phase with each other they will be in opposite directions in the lower and in the same direction in the upper winding.

The worst condition to be dealt with is that of a 90° displacement of phase between the two potentials. In this case the effect upon the differential solenoid will be the same as if both coils were connected in series with the common return of a two-phase system. Two independent currents lagging 90° behind each other will flow through both coils, and as they will be of the same value in each coil the core will be neither pulled up or down. This defect may obviously be corrected by inserting an inductive resistance in series with the potential supply A—B as suggested earlier in this paper. Another method of providing a cut-out that will take care of either a failing prime mover or a failing field is to use a double-barrelled relay, consisting of two differential solenoids connected in parallel —a non-inductive resistance being inserted in series with one and a highly-inductive resistance with the other. By this means the necessity of making adjustments, in each case to determine the best mean point for both conditions, is entirely avoided.

We sometimes find that engineers are a little uncertain as to whether discriminating cut-outs or reverse current cut-outs should be used in certain positions. The following rule appears to apply to all cases:—

"Where current is fed into bus-bars from a number of sources of supply connected in parallel, discriminating cut-outs only should be used. Where current leaves bus-bars to supply a number of feeders, transformers, motors or distributors, excess current cut-outs only should be used."

We are often asked whether a discriminating cut-out should operate instantaneously or whether it should possess some time element. On the whole the advantages appear to be on the side of instantaneous action. It is certainly desirable that a generator breaking down should be cut out of circuit with as little loss of time as possible, and with a reverse current of something less than the full-load current.

Apparently the only argument in favour of a time limit attachment, is that a reverse current device without time element is liable to be tripped by the rush of synchronising current from one generator to another when machines are being paralleled.

The simplest way of dealing with this difficulty appears to be either to switch off the shunt windings of the discriminating device at the moment of paralleling, thus rendering the device entirely inoperative or to greatly reduce the pressure across this winding when paralleling, thereby correspondingly increasing the reverse current required to operate the device.

DISCUSSION.

Mr. WOODBRIDGE doubted whether it was possible to obtain any device that would deal with all the conditions liable to arise in practice. A heavy short-circuit on a feeder would result in such violent surgings between all generators and synchronous apparatus connected in parallel at the time, that there would be a risk of some of the reverse-current devices being tripped by these currents. He doubted also whether a reverse-current circuit-breaker would isolate a generator should the resistance of its armature break down to earth, as, under these conditions, the bus-bar potential would fall to zero or thereabouts. The practice in some of the large stations in the States had been to solidly connect all generators to the bus-bars through hand-operated switches.

Mr. CLOTHIER thought the initial cost of the mechanically operated remote control gear referred to in the paper would probably be very much less than that of electrical control, but he would prefer to have a larger space between the phases. If the apparatus were made of double the size shown, it would be considerably safer. Referring to reverse-current circuit-breakers, he agreed with the previous speaker. A reverse-current circuit-breaker would certainly not deal with a direct short-circuit across the bus-bars.

Mr. ORTON contended that electrical control was not as complicated as it might at first sight appear. Mechanical remote control was quite satisfactory for circuit-breakers controlling 1,000 KW. or so, but was unworkable for the very large powers that sometimes had to be dealt with. For very high pressure, he considered it was necessary to completely isolate the phases.

Dr. GARRARD considered the principle on which the device shown in fig. 6 was constructed, to be wrong. With a 90° lag there would be no force on the moving part, that is to say, the device would not operate on a wattless current. To get over this fault Mr. Andrews proposed to put induction in series with the shunt coils. This was open to the very grave objection that if the device be then set to operate with a certain value of current lagging 90°, it would also operate with a larger current lagging less than 90° behind the voltage. It, therefore, followed that the device suffered from one of the very defects given by Mr. Andrews, viz., "(B) the device must not be released by a current supplied to a highly inductive load beyond the cut-out." A wattmeter device, with a given expenditure of energy, and other things being equal, should have a greater actuating force than the one described in the paper; especially as a wattmeter was generally a more efficient motor than an electromagnet. He had placed on the table a number of instruments which had been recently placed on the market by Messrs. Ferranti, Ltd.:—A wattmeter with a centre zero, to indicate whether a generator was motoring or generating, a reverse power relay, and a maximum alternating current time limit relay.

Mr. PEARCE cited two breakdowns that had come under his notice, due to the failure of generator fields. On one occasion the switchboard attendant detected the fault and switched out the faulty machines; on the other occasion he was unable to do so, and a complete shut down resulted, with very serious damage to the generating plant. What would be the effect upon the author's cut-out device should the E.M.F. fall absolutely to zero?

Mr. TOPLIS considered that it was very useful for the switchboard attendant to be able to see the running plant, as he was thus often able to detect a fault and cut out a faulty section without stopping to look at his instruments.

Mr. EUSTACE THOMAS thought that instead of attempting to belittle the author's work, as some of the previous speakers had

done, they should appreciate that perfection could only be achieved by persistently fighting and overcoming difficulties as they arose.

Mr. MCKENZIE mentioned that at one of the Manchester generating stations, they had at one time experienced considerable trouble with the Corliss valve gear on one of their engines. This occasionally got out of order when the defective plant was running in parallel with other generators, and sometimes caused the faulty generator to take a momentary current equivalent to 200 or 300 per cent. of its normal full load current. The defect was only of short duration, and immediately it was removed the faulty generator took its share of the load. If this plant had been fitted with a reverse current circuit breaker, it would have been cut out of action by this reverse current, and, consequently, they would have been obliged to re-parallel it.

Mr. COWAN thought that Mr. Woodbridge took up a most unreasonable attitude in condemning reverse current release gear because it would not deal with every condition which might arise in practice. Mr. Clothier's criticism of the danger of the exposed terminals at the back of the operating panel of the Poplar switchgear type was due to misunderstanding the arrangement. The operating panel was absolutely safe to touch, and work upon, both back and front, excepting when H.T. electrostatic voltmeters were fixed, and these were never used unless the customer specified them.

Mr. ANDREWS, replying to Mr. Woodbridge, was not surprised to learn that the latter's experience of reverse current cut-outs, had lead him to doubt their reliability. All the reverse current devices he had seen in use in the States were of a type that he should have expected to give trouble, and would never have thought of trusting the care of large generators to. But he was convinced that perfectly reliable devices could be made to deal with all the troubles that were liable to arise with one exception, viz., that of the pressure falling absolutely to zero. The only conditions under which such a fall of pressure would be liable to occur in practice, would be that of a metal to metal short across the terminals or leads of a generator; even under such drastic conditions the cut-out device would do no harm—it would merely remain inoperative. Whether discriminating devices were liable to be tripped by a short circuit on feeders causing heavy surging currents between generators, depended to a great extent upon the sensitiveness of the cut-outs. He had used discriminating cut outs for several years at Hastings, and had experienced many short circuits on the feeders, &c., when generators were coupled in parallel, but he had never known a cut-out released under these conditions. He was very interested to note that Mr. Clothier's ideas had undergone such a complete change since he read his classical paper on switchgear before this Section three years ago. The cubic capacity occupied by the gear Mr. Clothier now criticised as being too compact for 6,000 volts, was about 120 cb. ft. per 1,000 KW., whereas, when he wrote his own paper, he apparently considered about 60 cb. ft. per 1,000 KW. ample space for a 10,000-volt three-phase scheme. It should never be necessary for an attendant to work upon live connections; this had been fully provided for in the arrangement shown. Dr. Garrard had apparently failed to understand the remarks *re* phase displacement in the paper. He stated that the introduction of inductance in the shunt circuit was liable to make the cut-out operate on a current lagging less than 90° behind the voltage; it surely must be obvious that if the current in the potential winding was made to lag approximately 90° behind the bus-bar E.M.F., by inserting a highly inductive resistance in series with this winding, and if the current in the series winding also lagged nearly 90° behind the E.M.F., the currents in the respective windings of the cut-out device must be approximately in phase with each other, and consequently the holding-in pull on a highly inductive load would be much more pronounced than if no inductive resistance had been inserted in series with the shunt current. The power consumption at full load in the device shown by fig. 6, might be made anything that was desired, but he generally preferred to use a device absorbing from 60 to 100 watts, as by that means he obtained a very definite action. It was the very gravest mistake to sacrifice reliability in order to save ·005 per cent. of the total energy generated, this being the only saving on a 1,000-KW. machine that would be effected by using a device consuming 10 watts instead of one consuming 60. He considered that the use of these very delicate devices was the cause of the impression that had been allowed to grow that discriminating devices were unreliable. Mr. Pearce had cited two interesting cases which showed that the practice of trusting to hand-operated switches could not be relied upon. If the bus-bar pressure fell to zero, fig. 6, would remain inoperative. Excess current cut-outs should be used between the primary bus-bars and transformers, and reverse current cut-outs between the secondaries of the transformers and the low-tension bus-bars. Replying to Mr. McKenzie, he agreed that a reverse-current circuit-breaker would have isolated the faulty plant, and he thought that a generator that omitted to take its share of the load, but robbed the remaining generators of current to this extent, ought to be cut out of circuit until the defect was remedied. He thought that the general criticism of discriminating cut-outs, by all of those who had spoken against them, when analysed, would be found to resolve itself into the simple statement that, although such devices might take care of nine breakdowns out of ten, they were utterly incapable of taking care of the tenth.

Mr. BERTRAM THOMAS proposed a vote of thanks to the author, and Mr. CLOTHIER, in seconding the vote, remarked that Mr. Andrews had always given his fellow-workers the benefit of his experience and difficulties. In fact, he knew no engineer who was always more ready and willing to do so. He considered they all owed him a debt of gratitude on this account.

PEEBLES TRAMWAY MOTORS.

THE Peebles (Type S) tramway motor is a good example of the more powerful class of tramway motor used on British tramway systems, being adapted for use either with medium weight cars making fast schedules over hilly routes, or for heavy cars on easier

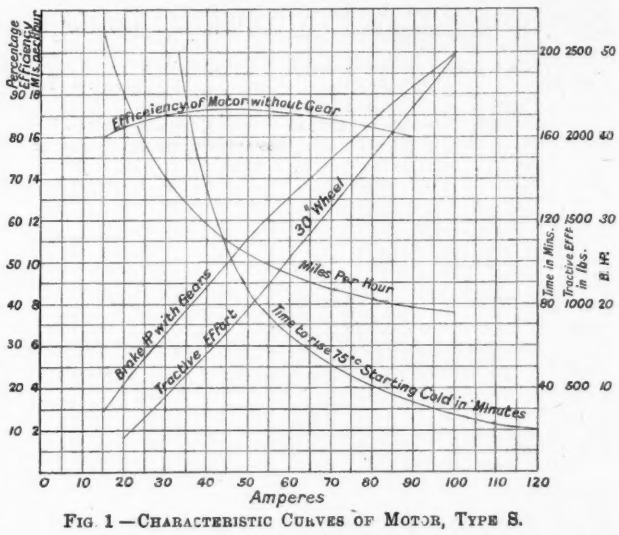


FIG. 1.—CHARACTERISTIC CURVES OF MOTOR, TYPE S.

systems. It will be seen from the curves, fig. 1, that, on a one-hour rating, tested stationary and totally enclosed, the output of the motor is 35 H.P., measured at the car axle, the efficiency with gears at this load being about 85 per cent. The efficiency is maintained very high over an unusually long range.

In external form and in the arrangements for suspension, &c., the Peebles motor is in conformity with the best modern practice, such as has now been practically standardised. The frame is of cast steel of the best quality, of roughly octagonal form, divided horizontally, the upper half of the frame carrying both the armature bearings and the car-axle bearings. Large doors in both halves

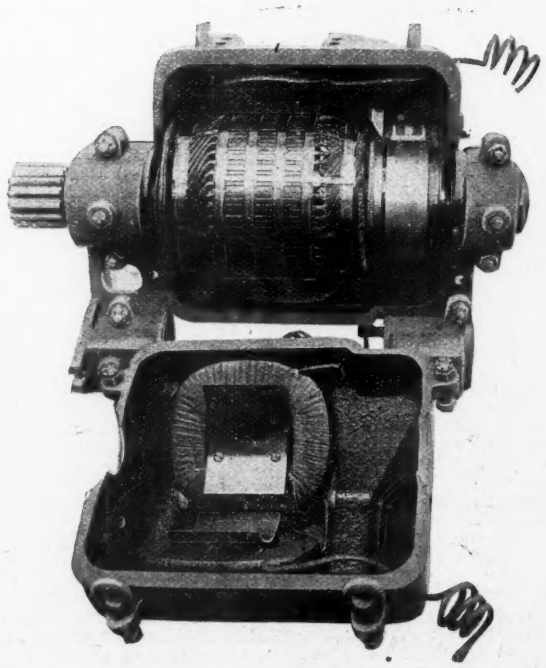


FIG. 2.—MOTOR WITH SHELL OPEN.

provide access to the commutator and brush gear. By loosening one or two bolts, the lower half of the field frame may be swung away from the upper half, and the motor is thus completely opened out for inspection over the pits in the car-shed (fig. 2). It is, further, a simple matter to remove the lower half field, and also the armature in its bearings, if required.

Each of the motor bearings is provided with two lubricant boxes fitted with spring lids and gaskets, and thus either oil or grease can be used, or both. The motor bearings are of gun-metal, each 7½ in. in

length × 3¾ in. diameter, the maximum diameter of the motor shaft being 4½ in. The axle bearings are babbitted, and are 4 in. × 7½ in. in standard motors, but the axle boxes are so arranged that a different size of shaft can readily be taken. The motor bearings are made of gun metal on account of the desirability of avoiding wear in these bearings, to prevent any liability of the armature touching the fields.

The leads are, as usual, brought out independently through insulating bushings from the lower halves of the fields, in order to avoid trouble when opening up the motor.

The motor has four inwardly projecting solid poles, fitted with long extended pole shoes of a form which absolutely prevents sparking, except at very heavy over-loads.

The field coils are of copper wire of ample section, carefully wound, taped and varnished, baked several times and insulated from the frame with press-spahn and mica. The weight is kept off

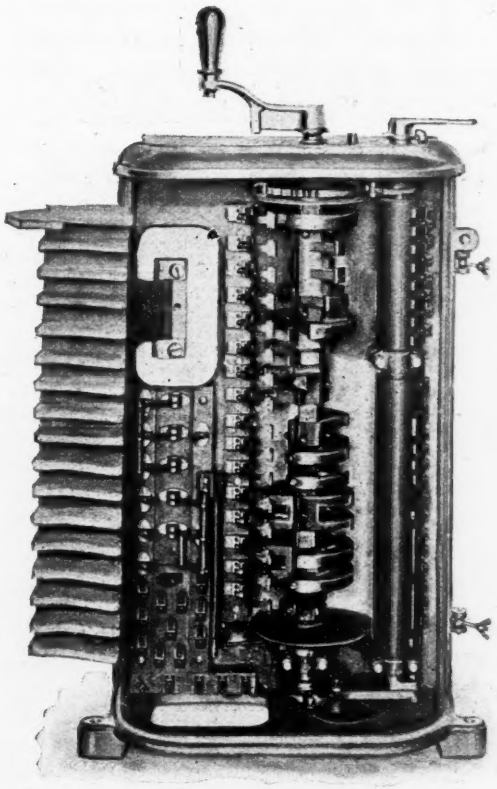


Fig. 3.—Interior of Controller.

the pole tips by the use of substantial cast-iron clamps. It will be noticed that laminated poles are not used; Messrs. Bruce Peebles have never believed in the lamination of field circuits for continuous current machines, regarding this practice as a survival from the days when continuous current armatures were made with a small number of teeth and large slots, and when, in consequence,

Fig. 4.—Armature of Type S. Motor.

the eddy currents caused in a solid pole face were quite considerable. With such armatures as are used in the Peebles motor, having a very large number of slots, these eddy currents are reduced to a negligible figure.

From a commercial point of view the use of solid poles has the advantage of making a somewhat more liberal design of the other portions of the motor possible, and thus improving the output, commutation, and efficiency of the motor. The armature, fig. 4, has 49 slots, and 147 segments in the commutator. The latter is of ample depth, and allows about ¾ in. reduction in diameter; owing to the special form of pole-piece which is adopted with the solid poles, the sparking is reduced to a minimum which greatly prolongs the life of the commutator.

The armature core plates are clamped between end plates of the form usual in traction motors, and the windings are held in place by four bands insulated from the core and windings by mica. Additional bands over the ends of the conductors both at the commutator and at the other end of the armature prevent spreading of the coils, should the armature attain an undue speed. The armature has further been designed with very small fly-wheel action, thus reducing the amount of energy dissipated at every stop, and reducing the amount again stored up in the armature at starting.

The brushes, which are of carbon, slide off machined surfaces in substantial box type brush-holders, and are pressed down on the commutator by suitable triggers. The brushes are very easily removed, the type of brush-holder being the simplest possible.

The weight of the motor complete, together with the bearings, brasses and pinion gear and gear case, is approximately 1 ton.

Any type of suspension can be arranged for if required; as a general rule, however, the "nose" type of suspension is found most satisfactory.

The motors are, of course, ordinarily used in pairs on a car with series-parallel control. The controller used, fig. 3, is of the magnetic blow-out type, and has in all three drums:—A main drum at which the breaking of the circuit in service always takes place, a reversing drum, and a further small drum actuated by a rack from the main

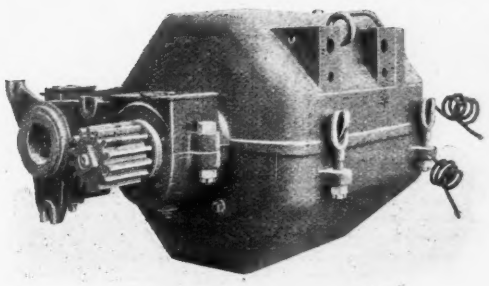


Fig 5.—Type S. Motor, complete with Pinion.

drum, the positions of the contacts on which determine whether the motors are connected for braking or running. The controller has five series and four parallel running positions, besides four positions intermediate between the first parallel and the last series notch, and there are also seven braking positions for use with ordinary service rheostatic braking, or with an electro-magnetic brake.

A large blow-out coil is fitted to reduce sparking at the contacts, and a number of breaks in series are arranged for when a heavy current has to be broken; for instance, in turning from the first series notch of the "off" position, the current is broken at six points in series under the influence of the magnetic blow-out. Provision is made for cutting out either motor should, it be injured, and with one motor cut out it is impossible to move the main handle of the controller beyond the last series position with no resistance in circuit.

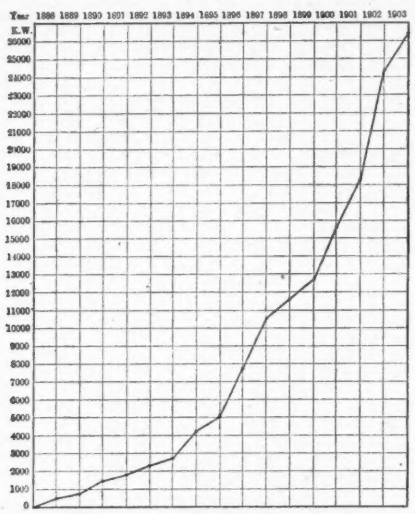
ELECTRICAL INDUSTRY IN JAPAN.

The position of electrical development in Japan, like everything else relating to that remarkably progressive country, is of great interest just now. We, therefore, publish from the New York *Electrical World and Engineer*, the accompanying curve which shows the growth in the total capacity of Japanese central electric light stations between the years 1888 and 1903. This curve is taken from a chart compiled by the Nippon Denki Kiokwai, the Japanese Electrical Association, which association was founded in 1892 for the purpose of investigating and reporting on matters of importance to the electric light industry; to represent the industry before the Government, to publish its proceedings, popularise electricity, and maintain in Tokio a permanent electrical exposition. The membership of the association is divided into three classes, namely, honorary members, individual members and companies and firms. A general meeting is held annually, and intervening general meetings may be called by the president. The executive committee meets monthly. The fee for individual members is $2 per year. The fee for companies and firms is graded according to the paid-up capital of such members, and ranges from $200, corresponding to $1,000,000 capital or over, to $10, corresponding to $100,000 capital or less. Only members of the association are allowed to exhibit their goods in the permanent exhibition building in Tokio. The building is open 12 hours each day, excluding Sundays and national holidays. All expense connected with the arrangement of exhibits for special electric lighting or for operating machinery is borne by exhibitors. A library is also maintained in the building for the benefit of members of the association. In case of applications for purchase, the authorities in charge of the building offer every facility toward bringing the purchaser in communication with the

seller. The total area occupied by one exhibit is not allowed to exceed 3 cb. ft. and the total weight cannot be over 1 ton.

From the same electrical contemporary we gather that in October, 1904, Japan took from America over 100 per cent. more electrical machinery than in October, 1903, and increased its imports of steel and manufactures of steel ordered from the United States. The war between Japan and Russia has had the effect of more than trebling American exports of electrical machinery to Japan. In the 10 months ending October last Japan took $899,199 of American electrical machinery as against $251,168 for the 10 months ending October, 1903.

According to the *Vossiche Zeitung*, Germany's trade with Japan in electrical goods such as accumulators, lead cells, cables, electric motors, telegraph and telephone appliances and instruments, lamps, &c., shows a considerable increase. Our contemporary says that Germany has



ELECTRICAL DEVELOPMENT IN JAPAN.

surpassed England and ranks second, the United States being first, and also that the Japanese manufacturers have not accustomed themselves, and will not do so, for a long time to come, to look upon a trade mark as a guarantee of an invariable quality and workmanship. In electric motors, English and American competition are the only factors which enter into consideration, and with a proper display of energy this field cannot fail to widen.

This information is made in Germany, where some writers and traders affect the belief that the British are no longer a great nation of shopkeepers as they once were. In this connection it is interesting to draw attention to the statement appearing on another page of this issue, which announces the despatch of a big consignment of British electrical plant, &c, for Tokio.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

27,698. "Improvements in vapour electric apparatus." C. P. STEINMETZ. (Date applied for under Patents Act, 1901, December 19th, 1903, being date of application in United States.) December 19th. (Complete.)

27,683. "Improvements in kummeters or instruments for the measurement of wave-lengths in wireless telegraphy." J. A. FLEMING. December 19th.

27,702. "Method of winding for asynchronous electrical machines for producing a variable number of poles in the proportion of 1 : 2." SIEMENS-SCHUCKERT WERKE GES. MITEKS HAFT. (Date applied for under Patents Act, 1901, February 13th, 1904, being date of application in Germany.) December 19th. (Complete.)

27,705. "Improvements in alternating current electric motors." B. G. LAMME. (Date applied for under Patents Act, 1901, February 27th, 1904, being date of application in United States.) December 19th. (Complete.)

27,707. "The manufacture of an indestructible filament for gas and electric lamps for lighting and heating purposes." G. MICHAUD and E. DELASON. December 19th.

27,713. "Process for the formation of incandescence bodies for electric incandescence lamps." W. P. THOMPSON. (Deutsche Gasglühlicht Akt.-Ges.) December 19th. (Complete.)

27,714. "Electric incandescence lamp with incandescence body fused in the conducting wires." W. P. THOMPSON. (Deutsche Gasglühlicht Akt.-Ges.) December 19th. (Complete.)

27,755. "Improvements in counting and mechanism more especially intended for use with electricity meters." H. ARON and O. RUNGE. December 19th. (Complete.)

27,762. "Improvements in electrical apparatus for regulating and distributing electric currents." C. G. CONRADI. December 19th.

27,773. "Improvements in and relating to the electro-deposition of metals or alloys on aluminium." C. MASON. December 20th.

27,783. "Improvements in the method of and means employed for supporting and connecting the trolley wires of overhead electric systems." T. DAWSON. December 20th.

27,786. "Improvements applicable to electric installations." F. KERSHAW and W. J. MCSWEENEY. December 20th.

27,804. "Improvements in self-regulating dynamos for train lighting and analogous purposes." C. D. CHARLESWORTH. December 20th.

27,881. "Improvements in incandescent electric lamps." W. GOULTON. December 20th.

27,842. "Improvements in electric tool drivers." P. A. NEWTON. (The American Inventions Co., United States.) December 20th. (Complete.)

27,859. "Improvements in and relating to self-acting cell-switches." ELECTRICITATS AKTIEN GESELLSCHAFT. December 20th. (Complete.)

27,860. "Forming tank for accumulator elements." W. GARDINER. December 20th. (Complete.)

27,861. "Accumulators." W. GARDINER. December 20th. (Complete.)

27,862. "Accumulators." W. GARDINER. December 20th. (Complete.)

27,869. "Improved construction of lock and electrical contact maker and breaker for lifts." A. C. BURNETT and J. RICHMOND. December 20th.

27,887. "Improvements in vapour electric apparatus." E. WEINTRAUB. December 20th. (Date applied for under Patents Act, 1901, December 21st, 1903, being date of application in United States.) (Complete.)

27,900. "Secondary batteries." W. GARDINER. December 20th. (Complete.)

27,901. "Storage cells." W. GARDINER. December 20th. (Complete.)

27,902. "Secondary batteries." W. GARDINER. December 20th. (Complete.)

27,903. "Secondary batteries and grids therefor." W. GARDINER. December 20th. (Complete.)

27,904. "Secondary batteries." W. GARDINER. December 20th. (Complete.)

27,905. "Grid or element for secondary batteries." W. GARDINER. December 20th. (Complete.)

27,908. "Improvements relating to magneto-electric ignition devices for explosion engines." G. MICHALEK. December 20th.

27,913. "Improvements in telegraphy." R. J. SHEEHY. December 20th. (Complete.)

27,916. "Improvements in locking apparatus for watchmen's electric controls and the like." H. HINDERSIN. December 20th. (Complete.)

27,926. "Improvements in or connected with electric demand or rebate indicators." F. M. LEWIS and THE REASON MANUFACTURING CO., LTD. December 21st.

27,929. "Improvements in electrically-operated block signalling apparatus." C. W. S. TURNER. (Date applied for under Patents Act, 1901, December 22nd, 1903, being date of application in United States.) December 21st. (Complete.)

27,950. "Improvements in fused electric motor switches." F. J. E. CLARKE and G. A. POPE. December 21st.

27,986. "Improvements in or relating to storage and other batteries." THE N.S. ELECTRIC STORAGE CO., LTD., and J. T. NIBLETT. December 21st.

28,018. "Improvements in safety discharge apparatus for excessive voltages in electric circuits." SIEMENS BROS. & CO., LTD. (Siemens-Schuckertwerke G.m.b.H. Germany.) December 21st. (Complete.)

28,036. "Means for automatically connecting up with each other the subscribers to telephone exchanges." J. PETICKY, I. CIZEK, and F. SUCHANEK. December 21st. (Complete.)

28,044. "Improvements in electricity meters." S. MATTHEWS. December 21st.

28,114. "Improvements in automatic controlling apparatus for operating electric switches or cut-outs." C. M. DORMAN, R. A. SMITH, and H. G. BAGGS. December 22nd.

28,122. "Improvements in and relating to electric ignition devices for internal combustion engines." J. PAXMAN and D. PAXMAN & Co., LTD. December 22nd.

28,123. "Improvements in, and connected with, counting apparatus for electric current, gas, water, or similar meters." F. BIERMANN. December 22nd. (Complete.)

28,129. "Improvements relating to permeable diaphragms for use in electrolytic cells, filtering apparatus, and like purposes." H. HIRTZ. December 22nd.

28,147. "Improvements in, or relating to, electric vapour apparatus, especially electric lamps of the character known as electric vapour lamps, or vapour arc lamps, in part applicable to other electric vapour apparatus." C. O. BASTIAN. December 22nd.

28,154. "Improvements relating to the manufacture of light emitting bodies for electric incandescent lamps." H. KUZEL. December 22nd.

28,156. "Improvements relating to the construction and ventilation of field coils of dynamo-electric machinery." THE PHŒNIX DYNAMO MANUFACTURING CO., LTD., and R. POHL. December 22nd. (Complete.)

28,157. "Improvements in, and relating to, actuating apparatus for magneto-electric spark ignition apparatus and the like." G. A. UNTERBERG. December 22nd. (Complete.)

28,163. "Improvements in telephone systems." J. YOUNG. December 22nd.

28,166. "System of connections for the generation of electric oscillations." G. EICHHORN. (Date applied for under Patents Act, 1901, December 20th, 1902, being date of application in Germany.) December 20th. (Complete.)

28,176. "Improvements in the method of, and means employed for regulating electrical energy in an alternating-current circuit." H. EMMOTT. December 23rd.

28,179. "Improvements in telephone indicators." W. AITKEN. December 23rd.

28,211. "An improved electric lamp for use by divers and others under water." J. B. STEWART. December 23rd.

28,212. "Improvements in connection with trolley poles for overhead electric traction." F. G. SQUIRRELL. December 23rd.

28,235. "Improvements in electric arc lamps." J. W. EWART. December 23rd.

28,252. "Improvements in or relating to electrical switches, plugs and the like." W. W. STRODE and G. H. WHITE. December 23rd.

28,254. "Improvements in electric telegraphs." F. RITCHIE. December 23rd.

28,255. "Improvements in electrical relays." F. RITCHIE. December 23rd.

28,268. "Improvements in and relating to telegraph transmitting instruments." F. H. W. HIGGINS. December 23rd.

28,270. "Improvements in or relating to safety devices and appliances for use in connection with suspended electric conductors." A. C. BRAY and W. AITKEN. December 23rd.

28,278. "Improvements in instruments for indicating the charged or uncharged condition of electric cables or other electric appliances." W. M. THORNTON. December 23rd.

28,301. "Improvements relating to electric welding." S. Z. DE FERRANTI. December 23rd.

Correction.—The names for Patent No. 27,479, mentioned on p. 1088 of our last issue, should be N. P. Andrew and *T. M. M. Johns* (not Macduff).

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

ELECTRICAL APPARATUS FOR SEPARATING COKE FROM CINDERS AND OTHER SUBSTANCES. H. Le Large. 5,799. March 9th.

ELECTRICAL APPARATUS FOR AIMING AND SHOOTING PRACTICE. The firm of C. Lorenz. 6,116. March 12th.

ELECTRIC ACCUMULATORS. H. Contal. 6,182. March 12th.

ELECTRIC ARC LAMPS. H. Beck. 6,905. March 15th.